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ABSTRACT

This compilation of reports is part of a planning project that aims to establish a coalition of organizations and key people who can work together to bring computerized telecommunications (CT) to Oregon as a teaching tool for science and mathematics teachers and students, and to give that coalition practical ideas for proposals to make CT a reality. The goal of this document is to provide potential users, potential CT providers, and interested citizens with information that will help them in working together on grant proposals. Reports in this document include: (1) "What Are the Current Visions for Use of Computerized Telecommunications in K-14 Science/Mathematics Education in Oregon, in the USA, and Internationally" (R. D. Frederick); (2) "What is Currently Being Done in Oregon, Nationally, and Internationally to Use Computerized Telecommunications in Educational Settings?" (Tim Lauer and Marion Rice); (3) "What Technical Systems Currently Exist, and What Can Current Technology Do?" (Martha Dean and Jim Worden); (4) "What Are the Barriers to Using Computerized Telecommunications in Educational Settings?" (Marc Sorensen); (5) "How Does Using Computerized Telecommunications Relate to Educational Reform in Oregon, Nationally, and Internationally?" (Daniel Domenigoni); (6) "How Are Educational Professionals and Others Currently Being Trained to Use Computerized Telecommunications?" (Michael Jaeger); and (7) "Technological/Social Trends for Computerized Telecommunications: Which Technologies and Organizations Will Best Ride the Wave?" (Deanna Campbell Robinson). Three appendices include charts and graphs; materials provided at "Telecommunications 101, The Oregon Telecommunications Forum, November 1, 1994"; and "A Paradigm Shift in K-12 Education" (Greg Bothun). (JRH)

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BENCHMARK REPORTS

OREGON'S TECHNICAL, HUMAN, AND ORGANIZATIONAL NETWORKING INFRASTRUCTURE FOR SCIENCE AND MATHEMATICS: A PLANNING PROJECT

This project was supported, in part,
by the
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INTRODUCTION

This project has a *really* long name with a colon in the title, making it properly academic. However, it also has a couple of simple (not the same as easy) and very practical objectives: (1) to establish a coalition of organizations and key people who can work together to bring computerized telecommunications (CT) to Oregon as a teaching tool for science and math teachers and students; and (2) to give that coalition so many good practical ideas for proposals -- ideas that will work with real schools, teachers and students -- that the coalition can secure funds to actually make CT a reality.

To do this, we are throwing together a mixture of teachers, technical experts, administrators, business people, college profs, informal science/math ed folks, and others. This assortment of potential users, potential CT provider, and interested citizens will listen to (and, we hope, *read*) Benchmark Reports, and discuss these reports with each other to establish some common language and background. They will then work together in Focus Groups to identify barriers that keep us from implementing CT in teaching, and to think up lots of ways to knock down, climb over, or go around those barriers. These ideas will end up in Focus Group Reports which will be sent to all participants. In January, representatives of the coalition organizations will assemble to turn these wonderful ideas into grant proposals. Because we are cooperating with each other rather than competing, we will do a better job for all of Oregon with the limited funds that we will be able to attract.

The Benchmark Reports are interesting and informative. Gus Frederick of AOI talks about vision for CT in Oregon. He reminds us that there are many visions, a lesson we re-learned politically just a few days ago. Marion Rice of OMSI and Tim Lauer of Buckman Elementary School in Portland (who is missing from this conference because he is also presenting at another conference) discuss a few of the many things that are being done with CT in Oregon and across the nation. We hope that participants will also tell each other about CT efforts in their respective schools. Jim Worden and Martha Dean of the Clackamas County ESD discuss existing systems -- a fact-filled paper that is interesting because it shows that we have so much already done in building this information superhighway. Marc Sorensen of South Medford High School discusses the barriers that teachers encounter in attempting to use CT in their teaching; I hope the technical experts and administrators will listen carefully. As you know, Oregon is moving toward educational reform. Dan Domenigoni of Milwaukie Junior High School will discuss how CT fits the demands of CIMS and CAMS and also the national reform movement. Teaching teachers to use the new tools will be of paramount importance in any widespread adoption of CT as a teaching tool, and Michael Jaeger of EOSC tells us about efforts in that area. Finally, as a bookend to Gus Frederick's vision paper, Deanna Robinson of the University of Oregon will talk about the future of CT and which technologies (and organizations) will be the most fit in riding the wave into the future.

Not on the program for presentation but included in this document are a series of background papers written for the Oregon Telecommunications Forum held a few days ago (including a glossary of all those terms like gopher and ftp), and a position paper from astronomer and CT expert Greg Bothun of the University of Oregon. Enjoy.

BENCHMARK REPORT 1: What are the current visions for use of Computerized Telecommunications in K-14 science/mathematics education in Oregon, in the USA, and internationally?

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OVERVIEW

The interesting thing about any sort of "Current Vision" is that the vision depends upon the eyes viewing it. In the case of Computerized Telecommunications, (CT) as it applies to K-14 science/math education, there are many eyes indeed. Over the last several weeks, I have been using these very tools to explore via the Internet, to attempt to get some sort of idea as to who these eyes belong to and what they are currently looking at. Hopefully, through this exercise we will try and determine which are 20/20 visions, which are wearing "rose colored glasses," and which ones are in dire need of an optometrist. Needless to say, there is no one "Current Vision," but rather a plethora of different ones.

In the film industry, like any creative endeavor, the director has a set of rules and guidelines that are usually followed. For example, when a new scene is introduced, the camera view is generally a wide-angle view. This view shows the big picture, and establishes the overall view. Next the camera usually moves to a medium shot, and then to a close-up. This formula is tried and true, in regards to film making, and is very helpful in keeping the viewers informed as to what is happening up on the screen.

Like a movie, I will also begin this report with the wide shot view of various international CT visions, and move the camera in closer next to our medium shot of the national view. I will then culminate with our ultimate close-up, focusing on our state of Oregon.

SECTION I - WIDE ANGLE: THE INTERNATIONAL VISION

To get a small feel of the international vision for CT, I choose the country of Iceland. I had spent 13 months in Keflavik, Iceland while in the United States Navy during 1976. While there, I feel I was able to get a good feel for the society of this most northern of European countries. It was said while I was there that every other store in downtown Rekjavik was a book store. While not exactly accurate, I did indeed notice that reading was one of the major cultural pastimes. One notable fact about Iceland, is its long term dedication to not only universal literacy, but continuing education for all its citizens. In spite of the fact that over fifty percent of Icelanders live in rural areas, the country boasts one of the largest literacy rates in the world, surpassing even the United States.

It really came as no surprise that I discovered several gopher servers on this unique volcanic island. I obtained a number of e-mail addresses of various individuals, and asked them via the Internet what their country was doing in regards to these new information technologies. I received three responses literally hours later! The most detailed of which was from Ms. Lara Stefansdottir, the Educational Director of the "Icelandic Educational Network," known by its Icelandic acronym of "ISMENNT."

In her reply to my query, Ms. Stefansdottir writes: [1] "The Icelandic Educational Network (ISMENNT), is Internet based and connected to over 90% of schools in Iceland. The Icelandic population is just approx. 260.000 and Ismennt is the main Internet provider for the educational field. We have computers in Reykjavik, Akureyri and at Kopasker where our headquarters are located." Here in her words is how her country made use of CT for education:

"For the last decades use of computer communication has been growing fast in the world. In Iceland the development has been similar but the use of data communication in schools has been growing faster than almost anywhere in the world. The reason is not an administrational decision but the interest from the schools, teachers and schoolmasters.

"The story of the Icelandic Educational Network (ISMENNT) started in a little village, Kopasker, in northeast Iceland in 1986. In this village, with only a little over 100 inhabitants, the headmaster Petur Thorsteinsson became interested in computer communication. He saw great possibilities in this medium for Icelandic teachers. He established his own host computer in 1988. Two years later, other schools in his district connected to his center, which he named "Imba." Interest increased, and one school after the other decided to connect to Imba. In 1992, Mr.

Thorsteinsson's effort lead to the establishment of ISMENNT. He was supported by various educational institutions and later on by the government of Iceland. Now, well over 90% of all educational institutions in the country are connected to the network. It is interesting that originally, ISMENNT was not built by computer specialists or an official institution, but a headmaster, supported by teachers, with help from computer scientists.

"ISME NNT is on the Internet and all users have access to tools like gopher, ftp, telnet, nn (news), e-mail and so on. The users can log on to three computers located at three different places; Akureyri, Kopasker and Reykjavik. They can connect through dial-up lines, X-25 and now recently TCP/IP. Because the use is growing fast the 54 Kb high speed line out of the country has been slowing things down but it's capacity will be increased within few weeks to 128 Kb.

"For the staff at Ismennt the first assignment was to connect the schools to the net. It was different from school to school how much technological knowledge there was within each institution. Usually it was fairly little when it came to computer communication. Therefore it was decided to visit each school and assist with technical solutions and the first steps into the network. The Teachers Association was ready to pay all travel costs for a year, and thus we were able to visit all schools that asked for connection no matter how small and remote the school is.

"Schools with a tight financial budget could not usually afford to buy more than a modem, so they had to use the computers they already owned. The schools have many different types of computers such as Archimedes, Macintosh and PC compatibles. We felt that it was our duty to connect whatever type of equipment we met at each place. With well-trained technical staff this was possible.

"After having connected the schools this way it was also easier to support them afterwards because we then knew the situation in each school. When the schools have been connected and our contacts at each place obtained basic knowledge on how to connect it is important to support the teachers and the staff. We offer series of on-line courses. All our courses are 20 study hours and certified by the Ministry of Education.

"10-15% of Icelandic teachers have attended the courses and one teacher from USA. When teachers get good support they learn faster how to make the on-line world a part of their classroom. Our aim is to help the teachers, no matter how much they know computers, to use computer communication. Often the first time the teachers use computers are when they decide to use our system.

"When a teacher has learned to use the system it is important that he/she gets support on how to use computer communication with the students. Although a teacher is comfortable using the system on his own he might not be so with his students. And it is not always obvious what he should do, how he should relate it to the existing curriculum and how he should plan the work with the students.

"At ISMENNT there is an educational director whom the teachers can contact when they need support, contacts, ideas, projects and so forth. We have gained important contacts within the field all over the world and collected knowledge of on-line projects.

"We support the KIDLINK project for children (aged 10-15) since we have found it to be very useful in this field. Their teachers can work with other teachers all over the world on issues related to their work. In KIDLINK there are different projects for children such as topics and projects for classes and individuals, chats (IRC, e-mail) and a gopher. Through KIDLINK the children learn a lot about other cultures and countries since thousands of children from nearly 60 countries have participated in KIDLINK.

"When establishing a network like the Icelandic Educational Network it is very important to do the work with the users views constantly in mind. The network is built up by teachers and a schoolmaster for the schools, it is privately owned by them.

"Day by day use of the network, made by teachers and students, grows. We live on an island that is rather remote compared to many others, it is expensive for us to cross oceans to meet people and learn about other people. With Internet that is the Icelandic Educational Network, it is possible to meet people from other cultures and countries every day, work with them and through that - learn."

Ms. Stefansdottir added in her correspondence with me that ". . . access to Internet (in Iceland) is one of the best in the world, if EEMA Briefing from the European Electronic Messaging Association is true. Eric Arnum writes that Internet computers in Iceland are more than in China, India, Russia and Indonesia together, (per capita). The population in all these countries is 2.4 billion compared to our 260 thousand. The growth of Internet computers between the years 1993-1994 is 159,6%. They say that there are 3,268 Internet computers in the country, (Iceland)."

The key visionary point in the case of the Iceland Educational Network is that it was instituted from the bottom up. For example, Mr. Thorsteinsson, a Headmaster, (Principal) of a local rural school thought that Internetworking would be good for his school and got the ball rolling by way of potential end users, (mainly teachers) of the system. Contrast this to a governmental agency mandating technology from above down to the local level. In this case, the end users built the system that they end up using. More importantly, it works!

SECTION II - MEDIUM SHOT: THE NATIONAL VISION

The "current" national CT vision is wide and varied. From the very top, we have the House Resolution 1804; the "Goals 2000: Educate America Act" recently passed by the 103 Congress, and signed by President Clinton on March 31, 1994. Under Section 102.5 of the act entitled [1.] "National Education Goals," we find the following:

Mathematics and Science.

(A) By the year 2000, United States students will be first in the world in mathematics and science achievement.

(B) The objectives for this goal are that--

  (i) mathematics and science education, including the metric system of measurement, will be strengthened throughout the system, especially in the early grades;

  (ii) the number of teachers with a substantive background in mathematics and science, including the metric system of measurement, will increase by 50 percent; and

  (iii) the number of United States undergraduate and graduate students, especially women and minorities, who complete degrees in mathematics, science, and engineering will increase significantly.

Needless to say, these are quite lofty goals! But they are attainable I feel with the proper coordination with all parties involved. Of course a strong emphasis in CT as a key component of these aspirations will help them become reality all the quicker. Like the case of Iceland, I feel that a strong involvement with the end-players is essential. ***In other words, we need systems built by the educators and students who will be using them.***

Unfortunately, our country in the past has been more likely to pursue the "word from on high" approach: i.e. Federal mandates from Washington telling everyone to do things in a uniform way. One sees this even in the Goal 2000 material! Fortunately, we have been getting away from this approach, as those Federal bucks dry up, and localities fight back at unfunded mandates. What has resulted are a vast number of pilot, experimental and test-bed projects around the country in use today. And since many are on the Internet, they need not be tied to any one area. And we all can easily check up or even join in with them. Here is a small sampling geared specifically towards math and science education:

2. PBS MathLine, the nation's first telecommunications-based educational service, is aimed at improving math performance, includes professional development for teachers as well as classroom services for students. It was chosen to represent the goal of "Teacher Education and Professional Development."

MathLine is being developed by PBS in partnership with the National Council of Teachers of Mathematics, (NCTM). The first project, the "Middle School Math Project," includes: a series of 25 videos that model NCTM curriculum, evaluation, and professional teaching standards; electronic learning communities overseen by practicing "master" teachers; and live, interactive national video conferences for teacher-participants.

MathLine is one of many classroom services provided by public television, which is also the leading source of classroom television programming for grades K-12.

On May 17 of this year, the Clinton Administration honored PBS MathLine as one of eight educational initiatives and services targeted to achieving the National Education Goals. The Public Broadcasting Service (PBS) was the only non-school based service and the only television network invited to participate in the event.

MathLink is a part of the broader PBS ONLine which includes the K-12 "LearningLink" system. PBS ONLine is a computer-based, interactive umbrella service designed to encompass a multitude of educational online services currently under development. Expansion plans for PBS ONLine include providing multimedia services combining video, text, graphics, and photographs via a WWW link. PBS Online is a key strategy to reposition public broadcasting for the changing telecommunications environment where television and computer technologies to transform the way television is used and information is delivered.

3. Newton - Another quasi-governmental Internet service is the Argonne National Laboratory's "NEWTON" BBS system. Argonne National Laboratory (ANL) is located approximately 25 miles southwest of downtown Chicago, Illinois. ANL is a multipurpose research

laboratory, owned and operated by The University of Chicago, for the United States Department of Energy (US-DOE).

The primary purpose of NEWTON is to promote math, computer, and science education via teacher networking. The primary users are teachers in these fields. This does not exclude other users and uses, but promoting math, computer, and science education will govern all allocation of resources and future features and developments of NEWTON. This BBS is an open system; users are allowed to register on-line and gain access to the system free of charge.

NEWTON grew from the conception of teachers involved in the Argonne Community of Teachers (ACT). ACT is a network of teachers, organized by ANL's Division of Educational Programs to promote math and science education. This group's idea to electronically network to exchange ideas and files for it's newsletter has given birth to NEWTON. As the founding organization, the majority of the moderating on NEWTON is done by members of this group. It is important to note that these moderators are volunteers. Most of the time spent by ANL staff on maintenance and operation activities is done on personal time as well.

The NEWTON system provides four different modes of access to better facilitate the wide range of systems and users, including modem via access to standard dial-up phone lines, telnet and anonymous FTP access where one can upload and download files through the Internet. And finally, World Wide Web access for Mosaic and similar high band users.

NEWTON offers a multitude of services that include but are not limited to: "Ask A Scientist" - an area where you can drop off a question which will be answered by an scientist. Telnet to the University of Michigan weather site - you can find up to date weather information for all areas of the United States and Canada. Telnet to NASA Spacelink - receive the latest information on space programs with an extensive teacher resource area. Also available are subject discussions covering all areas of math, science, and computer education, as well as the networking of grade school, high school, and college teachers with scientists from all over the world.

These two are but two of many national CT visions. But as one delves into the various gophers, Telnets and Fingers, it becomes obvious that the concept of "country" somehow gets lost in the shuffle. The national vision really can not be defined nationally.

SECTION III - CLOSE-UP: THE VARIOUS VIEWS FROM HERE

So that brings in for our close-up shot: The vision for Oregon. Should we go for some all encompassing mega-service or instead rely on smaller, more locally run systems. My feeling is that we will need to explore both avenues, and others as well. The nature of the Internet in general and CT in particular is that our basic way of looking at education and communication needs to change. This is the oft-touted "paradigm shift," one of those new buzz-phrases bandied about.

With the Internet, concepts of local versus long distance becomes academic. I found this out first hand in the preparation of this report! I ask several people in Iceland, half way around the world for their visions before I go to bed, and by morning I have pages of information at my finger tips.

This information came via the global Internet, but I accessed it by way of a local Salem, Oregon phone number through the Oregon Ed-Net Compass system. I could have gone through other providers, commercial or public. The point being, there are many roads to the same location.

So what is our vision for our state? Ask different people, get different answers. Oregon of course has its own version of the Goal 2000, Oregon House Bill 3565 dubbed "Education 2000," or "The Katz Bill," for Representative Vera Katz, (D-Portland) one of the primary sponsors. Even though HB 3565 was passed and signed by Governor Roberts, there are vocal opponents to this plan. Most notably the [1.] Oregon Citizen's Alliance, better known for their outspoken opposition to gay rights. In an eight page tabloid piece distributed earlier this year, the OCA blasts what they see an erosion of local and parental control in our educational institutions.

In their "Statement of Concern," they object to Section 9.1, which apparently calls for a "comprehensive . . . school information system." Their reference also mentions the "Elementary & Secondary Integrated Data System" they see as some non-secure Orwellian super-database of student and family information. My guess is that they are referring to the Integrated Postsecondary Education Data System,[2.] (IPEDS), explained as being an annual series of surveys conducted by the National Center for Education Statistics (NCES) that provides a variety of data on the Nation's 10,500 public and private postsecondary institutions.

The National Center for Education Statistics (NCES) collects statistics on the condition of education in the United States, analyzes and reports the meaning and significance of these statistics, and assists states and local education agencies in improving their statistical systems.

NCES supports a wide range of activities. It provides policy-relevant data on issues such as access of minorities to postsecondary education and the impact of enrollment changes on institutions and the outcomes of education.

This group also sees as a threat the emphasis on the new global society which they see as an undermining effort designed to supplant basic America principles as freedom, our type of government and our economic system. This unfortunately is what they see the Internet as. A kind of wild, un-regulated source of child pornography, and a means to enslave our culture electronically.

To sum up, I would like to close with this little tid-bit from the net:

[3] "Information Gap Out There. The landlord of a graduate student here in town found out that she was using her personal computer and modem in her room to communicate via e-mail.

"He'd heard about the so-called 'Information Highway' and its potential for misuse from his friends (they're all in their late 70's) -- about how credit cards can be stolen, conversations eavesdropped upon, 'hackers' doing unspeakable things to programs, etc.

"In short, he banned her use of the computer not only on-line, but at all! He was, by God, not going to have someone operating on a military-initiated 'clandestine' communications system on HIS phone lines in HIS house, and that's all there is too it.

"I think I have the situation de-fused. I explained to him, verbally and in writing, how personal computers work with modems, how when they're turned off, nothing in them works, how they aren't turned on all the time, how they don't have remote sensing equipment in them, how none of his personal information is in the computer anyhow. Took several hours, and even now he's not sure I'm telling the truth.

"Point is this: This is the kind of mindset many folks out there in the non-computerized world have about these toys of ours. When you are surprised by opposition to better computers and courses for schools, and better on-line infrastructure for everyone interested in doing this, there remain a group of people (who vote like crazy) who view this whole thing with something beyond deep suspicion and approaching paranoia. There may be an on-line world someday, but there's a lot of folks out there who cannot even conceive of what it will be or why it's necessary.

Don Homuth

Don's message to us is that there are a lot of folks out there who know just enough about Computerized Telecommunications to be dangerous. So my position is that any part of a CT vision must include education of the people. A coordinated public relations system should be in place for this purpose. Not just for those using the systems, but for those who will be asked to foot the bill with their taxes. We may see that box on our desks as portals to other worlds and amazing information tools. But many, (too many!) of our fellow Oregonians see HAL 9000 and Big Brother.

The final vision turns out to be a hybrid between a kaleidoscope and a zoom lens: An ever-changing view with distance becoming irrelevant.

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P.O. Box 9276

Brooks, Oregon 97303

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From the Newsgroup "sigs.edcn"

via Oregon Ed-Net Compass

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BENCHMARK REPORT 2: What is Currently Being Done in Oregon, Nationally, and Internationally to Use Computerized Telecommunications in Educational Settings?

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INTRODUCTION

This paper addresses the question: What is Currently Being done in Oregon, Nationally and Internationally to use Computerized Telecommunications in Educational Settings?

For the purposes of this paper the terms "computerized telecommunications" means the use of computers and data lines to communicate, access and share information across distances.

The issues set forth in this paper are intended to be of interest to multiple school stakeholders such as parents, administrators, teachers and students.

Across Oregon, nationally and internationally students and teachers are beginning to gain access to the Internet and other telecommunications services. The integration of telecommunications into classrooms has inspired the growth of many educational projects and collaboratives. The purpose of this report is to highlight a number of projects which exemplify how telecommunications is being utilized by teachers and students in the classroom.

ELECTRONIC MAIL

Electronic mail, or e-mail, is one tool that teachers and students are utilizing a great deal. The reason for this is that e-mail functions without a full connection to the Internet. Through e-mail, teachers and students are able to exchange information and ideas with peers locally as well as globally. Examples of this type of activity used for classroom instruction and learning can be found in abundance. For instance, in Nancy Zimmer's Structured Learning Center B classroom, e-mail allows her students to share their weather observations with peers in another first grade classroom in New Jersey.

A program called Math Magic, provides a forum in which students collaborate to solve opened ended inquiry based math problems. It provides strong motivation for students to use computer technology while increasing problem-solving strategies and communications skills. MathMagic posts challenges in each of four categories (k-3, 4-6, 7-9 and 10-12) to trigger each registered team to pair up with another team and engage in a problem-solving dialog. When an agreement has been reached, one solution is posted for every pair.

TEACHER PROFESSIONAL DEVELOPMENT

Examples of teacher professional development which utilize e-mail on telecommunications networks are: List serves, classes and workshops. Teachers in the Portland metropolitan area have banded together through a local organization called MACEP (Metropolitan Area Computing Education Professionals) to share ideas and information. While the group meets monthly, the majority of information sharing and development is done via an electronic mail listserve. This listserve is a computerized mailing list housed on a computer at Lewis & Clark College (listserve@lclark.edu subscribe macep). When a message is addressed to the list it is automatically sent to everyone subscribed to the list. Because the common denominator is electronic mail, individuals on commercial computer services such as America OnLine and Oregon Ed-Net-Compass are able to send and receive messages across networks.

Another example of a listserve that is being used for professional development is Kidsphere. Originally known as Kidsnet, Kidsphere was established in May 1989 to stimulate the development of an international computer network for use by children and their teachers. As a result of the success of Kidsphere an extensive mailing list now helps to guide its continuing evolution. Subscribers to the list include teachers, administrators, scientists, developers of software and hardware and officials of relevant funding agencies.

Topics discussed on Kidsphere include local, regional and national network issues, software interfaces for students, development of new network services and projects, and collaborative projects at the national and international level.

One recent posting on Kidsphere involved Nancy Scott's 2nd grade classroom in Paso Robles, California and their Toon Town Election project. This class, along with 50 other classes from the United States, Canada and South Africa took part in a mock election to elect a mayor of Toon Town. Students voted on November 8, and sent their ballots electronically to Nancy Scott's 2nd grade students who then compiled the results and sent returns to participating classrooms. This activity is a good example of the grassroots nature of many of the projects taking place via the Internet.

Teachers are involved in on line classes. For example, the Annenberg Foundation, Public Broadcasting and Bank Street College are currently offering a class focusing on interactive approaches to math in the classroom. The course involves enrichment materials (video tapes, lesson plans and reflective templates) which are sent to the participants as well as an on line component. The on line activities include sharing and reflection by teachers about the in class activities.

PARENT TEACHER COMMUNICATION

E-mail is emerging as a tool to increase and enhance communication between home and school. Parents, teachers and students who have access to telecommunications are using e-mail to communicate about educational issues. An example of this is the recent publication of the Buckman School directory. Along with the traditional address and phone numbers are parent and teacher e-mail addresses. In one particular instance a parent sent e-mail to a teacher in the classroom to say she was unable to come in to volunteer that day. In another instance, a kindergarten student e-mailed an older classmate to ask what happened at school on a day when she was at home.

NEWSGROUPS & ELECTRONIC BULLETIN BOARDS: K12NET

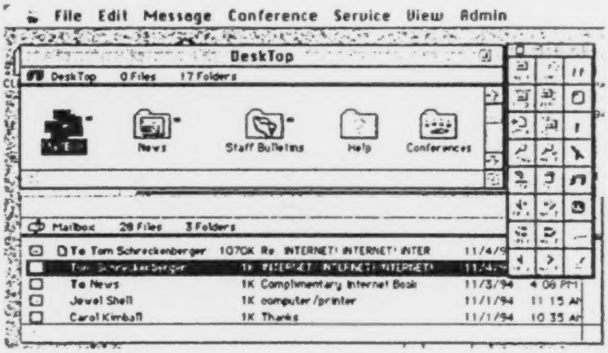
K12Net is composition of school "electronic bulletin board systems" (BBS's) throughout the world. The common purpose for K-12 net is to share curriculum information and projects through electronic conferences. Participation on this network does not require a direct connection to the Internet and has provided schools with a low cost solution to the expense of connecting to the Internet. This is especially important because of the inequities that exist in infrastructure to support telecommunications in many areas. K-12 Net provides a link between those on the Internet and those who aren't via Usenet Newsgroups.

Projects utilizing K-12 Net have covered a variety of academic disciplines. Students have engaged in weather data collection and analysis, creating Top Ten lists, collaborative math problem solving, creating cookbooks, sharing creative writing, scientific experiments and a myriad of other activities.

A specific example of the utilization of an electronic bulletin board system is work done by the OMSI Young Scholars during the summer of 1994. The National Science Foundation sponsored teams of high school students which conducted research at remote sites in Oregon (Hancock Field Station, Cascade Science School, and Three Lynx School, Upper Clackamas River). Each site was equipped with several personal computers, a modem, and a QuickTake digital camera. Each group stayed in daily contact with the others through the use of electronic mail and conferencing software. Students were able to share research findings and keep up with daily events taking place at the three sites. In turn this information was then put up on a World Wide Web server so that the students could more fully share their work with the outside world.

FirstClass

Electronic Bulletin Board Software



To Tom Schreckenberger 1070K Re: INTERNET! INTERNET! INTER 11/4/9

Tom Schreckenberger 1K INTERNET! INTERNET! INTERNET! 11/4/

To News 1K Complimentary Internet Book 11/3/94 4 08 PM

Jewel Shell 1K computer/printer 11/1/94 11 15 AM

Carol Kimball 1K Thanks 11/1/94 10 35 AM

GOPHER AND WORLD WIDE WEB RESOURCES

Gopher is a tool which is utilized to access and retrieve information on the Internet. Gopher lets users select resources from menus. The menus allow entrance to areas where information is stored without worrying about specific computer protocols (Krol, 1994).

World Wide Web (WWW) servers organize information on the Internet into documents which include hypertext. Hypertext provides the user with seamless transitions between documents. Navigational tools for the WWW such as Mosaic Netscape allow for the use of all the major Internet tools within one piece of software. Through Netscape, a user can access information on Gophers, FTP servers, Usenet Newsgroups, send electronic mail, and also access hypertext based information housed on HTTP servers.

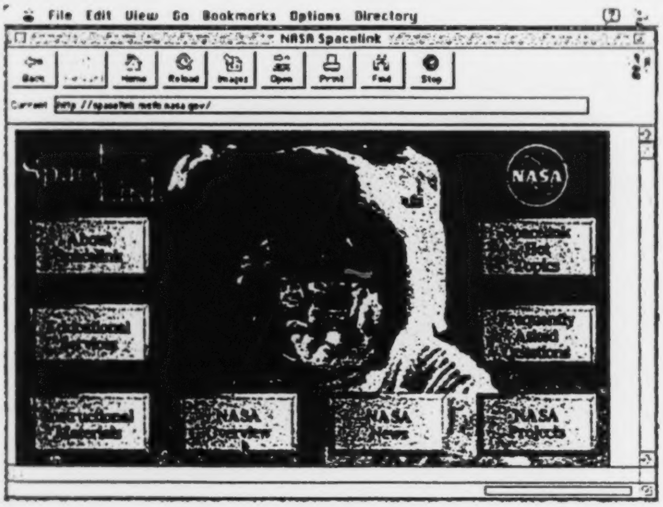
Schools are utilizing Gopher and the World Wide Web in a number of very meaningful ways:

- To access and add value to existing information
- To communicate with the outside world about educational issues
- To motivate students by providing an audience for their work

Many organizations which maintain Gopher severs have now established World Wide Web servers. In some instances the World Wide Web is the entrance to an organizations Gopher based resources. For example, The University of Illinois maintains a Web based server, The Daily Planet. This server contains links to images and interactive weather lessons and links to information about current weather conditions around the globe. In addition to the web server, The University of Illinois maintains much of this information on the Weather Machine Gopher server.

NASA maintains many Gopher and World Wide Web servers to provide public access to a vast collection of space related images and information. NASA has a particular interest in reaching out to teachers to promote the integration of science, math and technology in the classroom.

NASA Spacelink


File Edit View Go Bookmarks Options Directory
NASA Spacelink
Back
Home
Reload
Images
Open
Print
Find
Stop
Current
NASA
Instructional Materials
NASA Overview
NASA News
NASA Projects
Frequently Asked Questions

NASA Spacelink is the Agency's front end for electronic dissemination of educational materials through Gopher, World Wide Web and Telnet. NASA Spacelink offers a wide range of materials (computer text files, software, and graphics) related to the space program. Its target audience is teachers, faculty and students. Documents on the system include science, math, engineering and technology education lesson plans, historical information, current status reports

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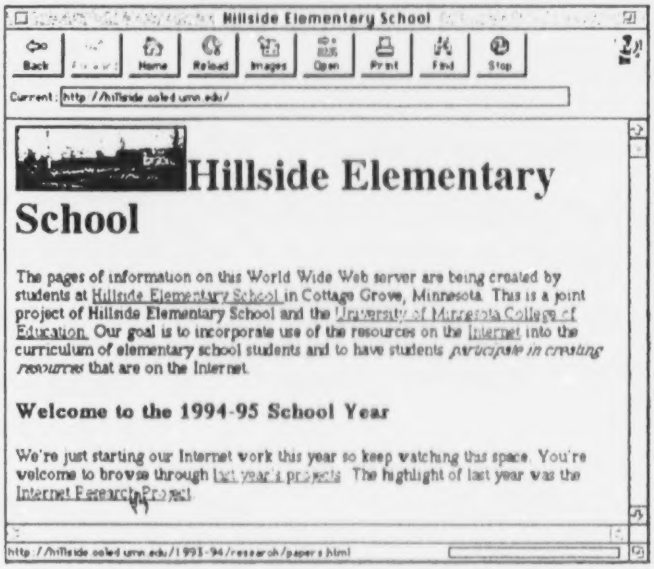
on NASA projects, news releases, information on NASA educational programs, publications, and other materials.

Hillside Elementary School World Wide Web Server



Current: http://hillside.coled.umn.edu/

Hillside Elementary School

The pages of information on this World Wide Web server are being created by students at Hillside Elementary School in Cottage Grove, Minnesota. This is a joint project of Hillside Elementary School and the University of Minnesota College of Education. Our goal is to incorporate use of the resources on the Internet into the curriculum of elementary school students and to have students *participate in creating resources* that are on the Internet.

Welcome to the 1994-95 School Year

We're just starting our Internet work this year so keep watching this space. You're welcome to browse through last year's projects. The highlight of last year was the Internet Research Project.

http://hillside.coled.umn.edu/1993-94/research/papers.html

SCHOOL BASED SERVERS

Some schools have established their own Gopher and WWW servers. Gopher and WWW allow students to access and add value to existing information. For example sixth grade students at Hillside Elementary in Cottage Grove, Minnesota, have used the WWW to find information related to a topic they were researching for a report. The students incorporated at least one source of information from the World Wide Web. They were also required to include one additional reference from the Internet: an e-mail message, some Gopher information, an FTP file, or an additional WWW reference. The students published their work on Hillside's WWW server and received approximately 880 visitors to their server over a two week period.

Vincent Ruggiano, a 5th grade teacher at Vose Elementary School in Beaverton, Oregon, has created an area with listings of resources of interest to the K-14 education community. Listed here are references for science, mathematics, humanities and social studies. By doing so he has created a starting point for teachers and students making their first explorations into the Internet.

One project that is utilizing the WWW to communicate with the outside world

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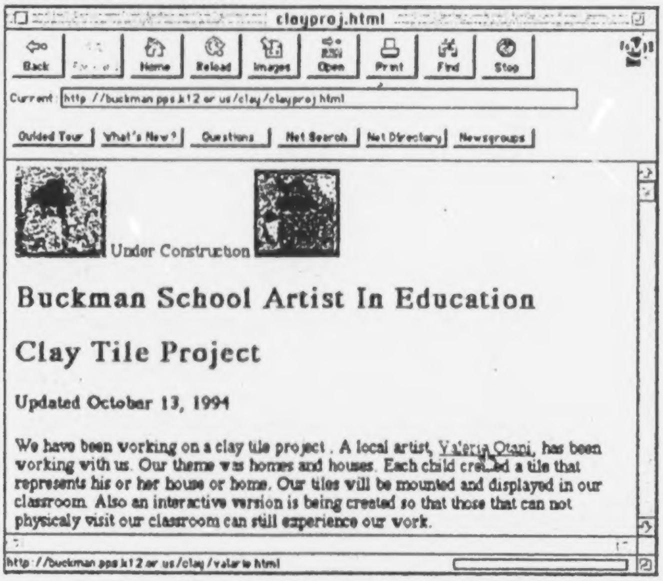
This project is attempting to transform science learning to better resemble the authentic practice of science, through project-based activities. Using state of the art scientific visualization software, specially modified to be appropriate in a learning environment, students have access to the same research tools and data sets used by leading-edge scientists in the field. As part of this project, students participate in the support of the CoVis WWW server. The project focuses on facilitating students inquiry into atmospheric and environmental sciences--including topics in meteorology and climatology.

Covis utilizes ISDN networks to enable high school students to join with other students at remote locations in collaborative work groups. Through these networks, students communicate with university researchers and other scientific experts.

The use of Gopher and WWW enables students to have access to an audience for their work other than their peers at school. This creates a strong motivation for students to engage in creating information which can be posted on the Internet. A multi-age classroom at Buckman School in Portland, Oregon has created a virtual art exhibit. A local artist volunteered her time to work with the children on the creation of a clay mural. The mural incorporated individual tiles created by the children. Upon completion, the mural will be displayed in a variety of places throughout the school community. In order to share the exhibit with people who would otherwise be unable to see it, a virtual exhibit of the mural was placed on Buckman Elementary School's WWW server. Internet visitors have come to the exhibit from many locations including: Iceland, Japan, Singapore and South Africa.

Buckman Elementary →
School World Wide Web Server



Current: http://buckman.pps.k12.or.us/clay/clayproj.html

Buckman School Artist In Education

Clay Tile Project

Updated October 13, 1994

We have been working on a clay tile project . A local artist, Valeria Otani, has been working with us. Our theme was homes and houses. Each child created a tile that represents his or her house or home. Our tiles will be mounted and displayed in our classroom. Also an interactive version is being created so that those that can not physicaly visit our classroom can still experience our work.

http://buckman.pps.k12.or.us/clay/valarie.html

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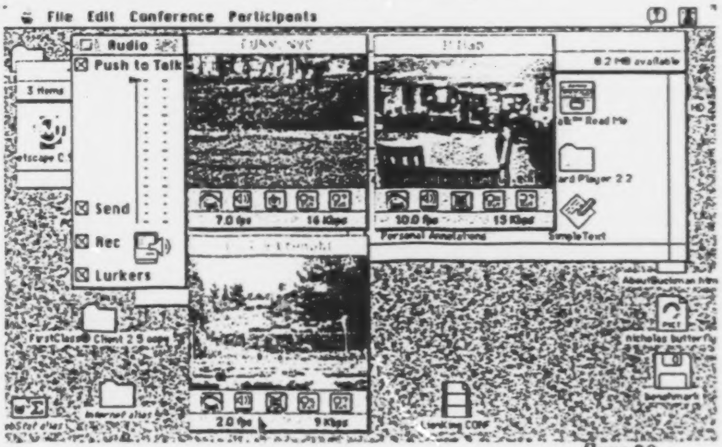
COMMERCIAL SERVICES

Commercial telecommunications networks such as America OnLine, CompuServe and Prodigy are fee based networks designed around product services and information. While some elements available on commercial telecommunications networks are available on the Internet, some are not. As telecommunications networks continue to develop, the line between services available on fee based networks and the Internet is being blurred. Examples of this trend include the development of The Scholastic Network, and TimeWarner's areas on both Americal Online and the Internet. Commercial Networks offer reliable access to information and services. These systems are well supported and are available in most areas through local dial up access. Each system has its own proprietary software that has been designed for the novice user.

For many educators their first experience using telecommunications is through these networks. Each of these systems has its own architecture for supporting interest groups. Educators gather around topics of interest and have the capability to download educational materials. Users are able to send e-mail out to the Internet through Internet gateways for information gathering, personal and professional communication.

An area where much experimentation is taking place is in video conferencing via the Internet. Software being developed at Cornell University called CU-SeeMe allows individuals with a direct connection to the Internet to engage in live video and audio conferencing with others on the Internet. The Global Schoolhouse project funded in part by the National Science Foundation is a project which utilizes this cutting edge technology. Collaborative research is conducted between students using a variety of Internet tools including CU-SeeMe. The Global Schoolhouse involves schools from California, Illinois, Iowa, Missouri, Nebraska, New York, North Carolina, Tennessee, Utah, Vermont, and Virginia.



CU-SeeMe,
Cornell University,
Video Conferencing
over the Internet

Locally, staff at The Oregon Museum of Science and Industry and students and teachers at Buckman Elementary School have begun to experiment with interactive activities and experiments through video conferencing. At this stage the image transfer for video conferencing is slow and users need to have a direct high speed connection to the Internet to fully utilize this technology. This technology has the potential to enhance the concept of audience that is a powerful motivational tool for students. Scientists have often found it difficult to visit classrooms because of their busy work schedule. Video conferencing technology will address this barrier and increase the potential for bringing experts into the class.

CONCLUSION

This report highlighted a number of projects which exemplify how teachers with access to telecommunications are utilizing it in the classroom. Access to telecommunications networks opens doors for students to find and add value to existing information and communicate with the outside world. Students are motivated to create and share information when they can tap into an audience for their work outside of the school community. Students, teachers and other members of the educational community collaborating on ongoing projects is a common use of telecommunications networks. The technology facilitates peoples ability to engage in varying levels of discussion, investigation and observation across distances. Teachers are linking up with one another to discuss educational issues and engage in professional development activities through telecommunications networks. Parents are communicating with teachers about their children and utilizing telecommunications to increase communication between home and school. There are a wealth of projects and people engaged in exploring telecommunications networks and doing some great things as evidenced by the examples in this report. The need exists to address access issues so that all students can participate in these activities.

REFERENCES

On-Line Sources:

Math Magic

http://forum.swarthmore.edu/mathmagic/what.html

MACEP

listserve@lclark.edu subscribe macep

Kidsphere

kidsphere-request@vms.cis.pitt.edu [Internet]

K12Net

gopher://rain.psg.com:70/00/schools/k12net/what-isk.12

OMSI Young Scholars

http://buckman.pps.k12.or.us/omsi/omsiys.html

The Daily Planet

http://www.atmos.uiuc.edu/

NASA Spacelink

http://spacelink.msfc.nasa.gov/

Hillside Elementary

http://hillside.coled.umn.edu:80/others.html

CoVis

http://www.covis.nwu.edu:80/

Buckman School

http://buckman.pps.k12.or.us/buckman.html

Global Schoolhouse

http://k12.cnidr.org:80/gshwelcome.html

Book:

Krol ,E.,& Loukides, M.(Eds.). (1994). The Whole Internet.Sebastopol, CA:O'Reilly & Associates.

BENCHMARK REPORT 3: What Technical Systems Currently Exist, and What can Current Technology do?

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Marylhurst, Oregon 97036

INTRODUCTION

This paper is intended to serve as a beginning point for others to add their knowledge and expertise about existing network systems and technologies in Oregon. It is a compilation of information gleaned from practitioners in the field of networking in the state, and is admittedly, incomplete for several reasons. The first of these is the element of time. Secondly, many who are putting together networks are so involved doing it that documentation of the technologies used is not easy to pull together. Thirdly, technologies and the levels of utilization change at a very rapid rate. The text and charts included as examples in this paper are as up to date as possible at this writing. There is a need to keep information updated as networks develop in Oregon.

The paper is organized with the networking technology available and its capabilities first, then the known networks in Oregon and some samples of the technology used by the networks. We have attempted to group the networks according to their function or the types of entities developing and using them.

We are assuming that the audience for this paper has an understanding of such things as what Internet is and what its resource possibilities are. The hardware, software and means of transmission available to the user will determine which Internet resources the user is able to access. Also assumed is an understanding of terms and acronyms such as: LAN, WAN, TCP/IP, Gopher, Mosaic, World Wide Web (WWW) and other such basic Internet and networking terms.

TELECOMMUNICATIONS TECHNOLOGIES

The wires and lines (sometimes called pipes) which might be used to connect to the Internet are varied in their capabilities. The broader the band capability, the more applications can be transmitted and the more expensive the line costs are. These lines, various capabilities and comparative costs have been listed and placed on a grid (Chart 1) by John Sechrest of the Computer Science Department at Oregon State University (OSU). The lines listed across the top of the chart are what is available now somewhere in Oregon. The capabilities listed on the left are those things users of Internet desire to access and transmit via the Internet.

Alternative telecommunications technologies are Frame Relay, Integrated Services Digital Network (ISDN) Cable TV, Satellite and Spread Spectrum Radio. The Cable TV services in the state are currently unable to provide data services. Oregon ED-NET uses satellite and cable TV. Most of the networks around the state use combinations of the technologies. In most cases the networks have been built from the local level beginning with e-mail capabilities and then adding on as technologies improve and needs (or wants) became apparent. Exceptions to this are some government agencies, industry and higher education.

Most access to the Internet is through the telephone companies. There are 35 different telephone companies in Oregon. For most of the state, the highest level of land based connectivity is a T1 dedicated line. The only place for advanced data media like ISDN, Frame Relay, T3 or ATM is between Portland and Eugene. ISDN and Frame Relay is offered only by US West and GTE. ISDN and frame relay are starting to move outside of the large centers but only by U S West and GTE. Most of the small telephone companies are not addressing the issue except for some members of the Oregon Independent Telephone Association. U S West has Frame Relay widely deployed in many cities. ISDN is only available in Portland and Eugene. ATM is not available commercially anywhere at the present time. Spread spectrum radio networks are beginning to become cost effective for short distances. It can make networking a small area of 3-10 square miles easier.

A survey of the networks for which we could get fairly recent information illustrates what diverse technologies are being used throughout the state. Part of this diversity is because of the funding for the agencies involved and the lack of a concentrated, adequately funded state effort to develop a high end system accessible at a reasonable cost. Generally, federal or state agencies, big business or higher education located in the Willamette Valley between Eugene and Portland have many options for access to the Internet.

HIGHER EDUCATION

Most of the private universities and colleges in the state are using 56k connections. Public higher education such as Portland State University (PSU), Oregon Graduate Institute (OGI), Oregon State University (OSU) and University of Oregon (UofO) have T1 connections to the Internet. Other public higher education institutions like Eastern Oregon State College (EOSC), Oregon Institute of Technology (OIT), Southern Oregon State College (SOSC), Western Oregon State College (WOSC) and Oregon Health Sciences University (OHSU) have 56k connections. Lane County Extension Office of OSU has a direct 56k frame connection to the university.

The Network for Education and Research in Oregon (NERO) Project sponsored by U S West and GTE has brought higher connectivity as a part of the ATM experiment to OSU, UofO, PSU, OGI and OHSU at 45-155 Mbps. The experiment is scheduled to be completed in January, 1995. All the OSU extension offices in the state have electronic mail via a mail gateway service.

COMMUNITY COLLEGE

The few community colleges that have connectivity are Chemeketa, Central Oregon, Mt. Hood, Portland Community College, Clackamas, and Lane. Chemeketa and Central Oregon have started working on network services such as World Wide Web services. Chemeketa offers classes based on email. Other campuses are in the process of developing their LANs and have not yet acquired the hardware and software for Internet connection.

OREGON ED-NET

Oregon ED-NET uses satellite transmission to offer teleconferencing on two networks. Network I is one-way video, two-way audio with 219 receive sites in operation as of June, 1994. Eight new sites were in progress at that point. Network II is two-way video and audio with 41 sites operational as of June, 1994. (Charts 2 and 3) COMPASS is a subscription dial-up network providing a full range of dial-up, World Mail, Internet and Telnetting services. There are 22 dial-up numbers throughout the state with lines varying from 2400 to 9600 baud. Portland and Salem have up to 14.4 baud lines. ED-NET is funded by membership, usage and subscription fees. ED-NET teleconferencing may be used by any government agency or business. A new Teleconferencing Center on Capitol Mall in Salem has just opened. Fees vary between members and non-members or profit and non-profit entities.

PUBLIC EDUCATION K-12

The Oregon Department of Education (ODE) has funded a contract through June, 1995 for services with NorthWestNet to provide Internet access to all teachers, administrators and students in Oregon. This is the second year of the contract.

It has been expanded to include the community colleges in Oregon. The network to carry the service is called Oregon Public Education Network (OPEN). Although the service has been paid for by ODE, the catch is that most K-12 districts have not built LANs yet, let alone the means for directly accessing Internet. OPEN is divided into two hubs through which schools can connect with Internet. One of the hubs is located at Clackamas Education Service District (Northern Hub) and the other is located at Eugene School District (Southern Hub). (Chart 4 illustrates the Northern Hub Frame Relay) Lane ESD, Linn/Benton/Lincoln ESD and Douglas ESD are connected through the Southern Hub. Washington ESD and Multnomah ESD are connected through the Northern Hub. Dave Moore of Linn/Benton/Lincoln ESD reports that their network serves the three counties with 56Kb leased lines connections using Novell netware networking. Email is available with Internet services beginning November, 1994. Yamhill ESD is in the process of acquiring the hardware for connection through the Northern Hub. The information services departments of the various ESDs have taken the leadership role in the development of OPEN. This has been done, for the most part, with little or no outside funding. ESD general funds have been squeezed to provide this additional service to schools. Accompanying charts show the Clacknet and Northern Hub frame relays and other technologies being utilized. Northern Hub administrators are making every effort through hardware and software acquisition to facilitate the Internet connections of the various LAN configurations which are already in place or being developed in connecting school districts and ESDs. (Chart 5)

Several schools have received computers and dial-up access to OSU through the SMILE (Science Math Investigative Learning Experiences) program. These are Woodburn, Pendleton, Willamina, Siletz, Madras, Ontario, Nyssa, and Chiloquin. Salem-Kaiser schools have access to three dial up lines at Willamette University.

Portland Public Schools, North Clackamas School District, Beaverton School District and Eugene School District are examples of districts making major commitments to the development of their LANs and providing teacher and student access to Internet. Portland and North Clackamas are connected through OPEN Northern Hub. Beaverton is connected by cable through Washington ESD to the Northern Hub.

LIBRARIES (Some may be covered under "Higher Education")

The Multnomah County Library and Washington County Library are currently online. Public and academic libraries are making major efforts to network libraries for the purpose of sharing resources and then to move to providing Internet service. Most public libraries are participating in various networks including multi-library automated public access catalog (Lane County), linked systems network (North Valley Library Link, Valley Link), CD-ROM public access catalog (Curry Libraries Area Network, South Central Oregon Public Access Catalog, Eastern Oregon Library Network) or regional bulletin board The Library Information Network of Clackamas County (LINCC) administered by Joanna Rood is in the process of installing a Hewlett-Packard Unix Model 800G50 with the Dynix software. This will provide 230 terminals throughout the county. Connections will be by telephone line.

Most academic libraries participate in some type of multi-type library automated system. (Chart 7) PORTALS, according to Millard Johnson, facilitates cooperation among libraries of institutions of higher education in the Portland metropolitan/five county area. PORTALS provides: linkage of academic libraries, databases for higher education and community researchers, menu access to library catalogs and other information resources on the Internet. Their Gopher includes everything of academic interest that can be found on the Internet. A Web Server is under development. Licensed databases are mounted on a SUN server using BRS search software. They use 56kb line with T1 from their main computers at PSU to the Internet POP. Internet access is from NorthWestNet. PORTALS is funded by Oregon Legislature appropriations through Portand State University. It is administered by a Board of Directors consisting of the president of each institution and a Council of Librarians consisting of the Head Librarian of each institution.

The University of Oregon and four regional colleges in Ashland, Klamath Falls, LaGrande and Monmouth, using funding from the Meyer Memorial Trust, will team to develop a statewide library union catalog of the libraries resources. UofO Librarys Technical Services Center will be upgraded to adapt easily to technological changes and support statewide access to information through computer modems and the Oregon ED-NET distance learning system.

GOVERNMENT ADMINISTRATION

About a year ago there were 42 separate government agency networks in the state. At this writing there are about 21. Government agencies are making a real effort to streamline and combine networks where it is feasible, cost effective and desirable. The Salem Mall provides a path for connections that is shared between many agencies. Charts 8 and 9 developed by Carl Grzybowski of the Department of Administrative Services illustrates the physical environments of the various government agency networks. (Chart 8 and Chart 9)

Almost no local county or city governments are connected directly to the Internet. A few have an email gateway. Lane County provides email access to Corvallis and Linn/Benton County governments. There is no direct service to the Internet and there are no information services provided.

COMMERCIAL SERVICES AND PUBLIC ACCESS

Providers of commercial connections to Internet in the Valley include: NorthWestNet, Rainnet, PSI, Alternate and Netcom. National vendors like Sprint, Cerfnet and others have points of presence only in Portland, Salem, Eugene and Pendleton. As cable systems around the state continue to rewire with fiber, more options for providing data networking over the cable network will become available.

In Eugene, the Oregon Public Networking (OPB) system provides free access. In Salem, Chemeketa provides BBS access - soon to have Internet. In Corvallis, OSU, CSOS PEAK provides access for a small fee. Most commercial providers have locations in Portland, Eugene and Salem. Outside of the Willamette Valley, the most inexpensive access is provided by Ednet Compass.

BUSINESS AND INDUSTRY

Large businesses in Oregon have Internet access. Companies included are Hewlett-Packard, Intel, Sequent, Tektronix, Freightliner, Hyster, and Boeing. Most of the small high tech businesses have connectivity but most other small businesses may have only an email service.

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BENCHMARK REPORT 4: *What Are the Barriers to Using Computerized Telecommunications in Educational Settings?*

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INTRODUCTION

The purpose of this paper is to present barriers to using computerized telecommunications in educational settings. This will be accomplished by first relating some of my experiences as I endeavored to find access to and learn telecommunications for classroom purposes. From these experiences, a list of barriers will be established. Secondly, I will summarize the results obtained as I consulted with other educators about networking in classrooms and the problems they encountered. Finally, a summary of related barriers found by consulting various educational publications will be presented.

It should be noted that I live and teach in Jackson County, Oregon. This southern region of Oregon is experiencing rapid growth. Medford, the county seat, is the center of commerce for this area, and has two public high schools, each with about 1500 students. The county has a total of 6 public high schools and several private schools. There is no internet access in this area at this time that is reasonably priced and complete enough to use in educational settings. As far as internet access is concerned, we are classified as a rural area, as is most of Oregon. Portland, Salem, and Eugene are the only areas with reasonable internet access in Oregon, for serious, academic use in the classroom. I am hoping that this changes soon It is hoped that the experiences and information contained in this report will be useful to those in Oregon and other states that find themselves wanting to incorporate computerized telecommunications (ct), into their curriculum but also finding themselves essentially starting with only this desire.

PERSONALLY ENCOUNTERED BARRIERS

When I wanted to learn about the educational possibilities of using the internet, I found that Delphi was the only reasonable access from Southern Oregon for individuals wishing to explore the basic tools of the net. Because of the rates and restrictions for evening and weekend hours, this was not access for general K-12 education. Oregon Ednet's Compass has two local dial-up numbers, but their current restrictions on access times for schools coupled with severely limited options made this unworkable for our school as well. Both of these services were exciting places for me to gain after hours experience and to meet gifted educators, but they also reinforced the perception that we are in an isolated area as far as educational computerized telecommunications. Other options that would provide complete service for a school were far too expensive and not serviced locally.

I soon learned that there were very few K-12 educators "on the net" from this area, and I knew that there were none in our school. Without access, there were no projects ongoing that I was aware of and no one experienced to collaborate with locally. I could now communicate after hours with other educators around the world, but I still felt isolated in the workplace. Finally, several teachers in my building were able to purchase Compass accounts using inservice funds, but they did not use them very often because of their own busy schedules. I still felt as if I were watching something exciting instead of participating in it, because I had very little if any time to learn by gaining experience with school access and projects.

I endeavored to try to find a way to get better access for our area. In doing so, I found that even those in the ESD were unable to move beyond acknowledging that Oregon had some vague plan for providing e-mail address for all teachers. I saw a statewide collaborative effort to expand services to rural areas fizzle to nothing as an eagerly awaited possible funding date for a grant simply came and went in silence. I could not get many local educators excited because they had no experience and no way to get experience. Several educators from other places urged me not to give up as we shared frustrations on-line, but it was discouraging. Finally, working with others after a meeting at Southern Oregon State College, a local steering committee was formed to find access for education, business, government and citizens. From this, several exciting possibilities began to emerge, but as of yet, nothing useful to education has come on-line. That may change soon.

From these and other experiences, I find that the following issues can be viewed as barriers to using computerized telecommunications in educational settings:

1. Lack of usable, affordable access in a geographic area is a problem.
2. There can be a lack of interest, experience and vision on the part of administrators and teachers.

3. Once awareness sets in, a lack of money is a serious barrier.
4. Lack of time to learn and gain first hand experience in educational settings is felt to be a barrier by many.
5. For those willing to learn at home, lack of equipment or local access is a problem. Some feel that dial-up access or a BBS format is not a good place to learn about computerized telecommunications. I feel it has its place.
6. A feeling of isolation when learning about a complicated technology can be a problem.
7. There is often a lack of desire to learn and use new technologies by educators. I am including classroom teachers, administrators, and service district support personnel.
8. There can be a lack of desire to learn a technology with no evidence of support.
9. Frustration associated with past experiences integrating technology in classroom settings can predispose teachers to pass on new technologies.
10. There is a different set of socioeconomic situations as far as access to computerized telecommunications is concerned. Smaller and less diverse communities do not have opportunities for the partnerships necessary to work a complicated technology and connecting costs can be significantly higher.

I believe that a word about time and other possible barriers is in order. Several respected teachers I work with mentioned time as a serious barrier for them. Three are coaches after school, in more than one sport. One other coach in another district had 5 preps before coaching started. Another teacher indicated that he would have to seriously curtail his reading and personal physical fitness routines in order to make the time to learn at home. Other educators I have talked with take the attitude that we make time for what is important and they discount the issue of time as a serious barrier. Time as well as other possible barriers needed to be compared to the experiences of others who are at different stages of using computerized telecommunications in educational settings.

BARRIERS EXPERIENCED BY OTHERS

It is evident that many schools and districts have had years of experience in using computerized telecommunications in educational settings. I desired to make contact not only with them but also with others who have access potential greater than that found in most areas of Oregon. I wanted to take the issues identified from local experiences obtained from early struggles with networking issues and see what experience and time contributes. I did this by talking with and surveying science and math teachers at a National Science Teachers Association conference held in Portland, Oregon during October, 1994. I also posted a similar survey to several news groups both on the internet and on more local discussion groups. The survey was posted in several educational listserves that had both regional and national coverage. The same survey was offered to teachers in an area with no reasonable internet access and no successful experiences with using computerized telecommunications in the classroom. I felt that this would be one way of obtaining input across a broad range of experience and opportunity.

People were asked to respond to previously identified areas of concern and they were provided with the opportunity to identify issues not specifically addressed in the survey. In addition, they were asked to respond to some issues by declaring if an issue was a valid concern for themselves and if the same issue could be considered as a barrier for others.

Initially, I was disappointed in the lack of numbers, but noticed the common barriers and issues cited from all who responded. Statistically, a greater number of responses would need to be obtained in order to do a more complete analysis, but patterns did emerge that not only seemed to validate local experience, but also matched concerns identified in literature. Following are the patterns that emerged from these interviews and surveys.

1. Most respondents were not using computerized telecommunications in the class.
2. Most schools do not have internet access and most are not networked internally.
3. Most respondents say that they know someone who does use computerized telecommunications in the classroom.
4. Most commonly cited reasons for not using ct in the classroom dealt with not having access, followed by issues related to not having the time to learn.
5. Equipment not being available at school (including phone lines not in the classroom) as well as not being available at home was cited more often than lack of training or lack of awareness of content area applications.
6. Issues cited least often were associated with money, parental objections, and lack of text for the students.

7. Slightly more than half of those responding used telecommunications from their home.
8. Almost all indicated that they would commit to learning ct if the district provided frequent, regular instruction. Those that indicated that they were unwilling simply qualified that the district commitment had to go hand in hand with a serious commitment to equipment and service. Even though one would think that this would be assumed to be linked with the training, they did specify that both had to be there.
9. Only a few individuals said that they would not undertake a serious commitment to learn ct at home if equipment or access were provided for them to do so.
10. When asked to specify incentives needed for them to commit to learning ct, equipment availability was #1 on the list of common responses. Following that slightly was time and then access. Obtaining specific applications for their content area was close to access, with continuous support and materials, money, instruction, released time, home access and recognition all being mentioned.
11. Most said that for them, lack of school support was not a barrier, but readily allowed it as an important barrier for others. There were still a number of them that did indicate that it was a barrier for them.
12. Twice as many indicated that time was not a barrier for them as indicated that it was, but most felt it could be a barrier for others.
13. Most felt that lack of parental support was not a problem for their teaching situations, but it was felt by half the respondents that it could be a barrier for others.
14. The majority of those responding had no problems with acknowledging the value of CT in the class for themselves and did not feel it would be a barrier for others.
15. Most felt that their supervisors supported it in theory at least and many felt that lack of support could be a barrier for others.
16. Very few felt that not being comfortable with computers for themselves or others was a barrier.
17. The vast majority said that changing what was working for them in the class was not a problem. Fewer indicated that it could be a barrier for other teachers.
18. Not knowing how to incorporate ct into their curriculum was identified as a clear barrier for themselves and for others.

19. There seemed to be very little difference in responses between those using ct and those not using it. There was little apparent difference when comparing the responses of those living in areas with greater access potential with the responses of those who lived in areas of no practical access. There was little if any difference in responses considering grade levels differences. I was surprised that the response differences between sexes was not apparent, but this will be addressed later.
20. Several people who were using ct in the classroom indicated that learning at home was very important if this technology was going to be used successfully in the classroom. They made it quite clear that continuous, regular support and inservice was critical as well. Since those actually using ct in the classroom were very few in number, I felt that their specific identification of issues was important. It could represent the voice of experience.

EXAMPLES OF BARRIERS IDENTIFIED IN EDUCATIONAL LITERATURE

A symposium report titled "Advancing Technology Use: Barriers to Research Utilization", by Elizabeth A. Lahm, Ed., (1989) contains a section that presents 5 categories of barriers to technology implementation that are applicable to most technologies and certainly the implementation of computerized telecommunications in classroom settings.

The first barrier described is the ***Equipment Barrier***. It includes issues surrounding inadequate funding for the equipment, and complicated equipment that requires intensive training and the development of new skills. Specifically mentioned is software that does not meet the needs of the targeted students.

Implementation issues that are listed as interfering with adoption include lack of short range and long range planning. Listed as well were no financial support for the teachers that have to put in extra hours to learn the technology on top of other duties and lack of technical support for when teachers need it. Another item listed was implementation that was attempted with out the input from the teachers who were expected to use the technology.

The ***Teacher Training*** issue listed barriers that included unclear choices of what to teach, lack of sufficient numbers of trainers for the teachers and no room in the existing curriculum for additional technology. Another item mentioned was that many educators are using technology to increase their production, but the technology does not find its way into the classroom for the student use.

Another category of barriers was those associated with ***Teaching as a Profession***. A number of specific barriers here are focused on the reluctance of teachers to break out of the patterns that they are in now. This includes teaching behaviors that were instilled when they were students in school, as well a the perception that technologies are just another passing fad that was initiated from the top down. Computerized telecommunications emphasizes collaboration and problem solving yet teachers were trained in content with competitive environments.

The category associated with ***Classroom Environment*** includes several issues associated with time and the work required to change current strategies. It was stated that in the past teachers have been oversold on other technologies and then the problems associated with these technologies makes it easier to resist newer ones later. There is a reluctance to break away form inexpensive, traditional methods like chalk, textbooks, and workbooks. The lecture format is still the preferred method of delivery and many teachers are uncomfortable with a technology that places them as learners with their students.

From "Consortium for Educational Telecomputing: Conference Proceedings" by Tinker and Kapisovsky, (1991) many of the above mentioned barriers were addressed and specific recommendations were made. In addition to ones mentioned so far, it was noted that an issue was the ***overwhelming number of information services*** available to educators trying to work out the specifics in their areas. Also, existing curriculum guides provide little if any telecomputing information, further complicating the time issues. Survey results indicated that the ***cost*** of this technology is indeed a problem as well as the perceived ***lack of enough models*** for integration. This makes it even more imperative that the teachers acquire skills in the integration of this technology and that places them operating outside their training on yet another level.

It should be noted again that various articles and papers cite many of the same issues and barriers, while often contributing insights that seem to be more readily evident from differing experiences and audiences. Even more popular magazines approach these issues, as evidenced by a recent article in "The Internet World" by Crawford Killian (Nov./Dec., 1994). In addition to describing a fear of the internet experienced by some teachers due to the technological complexity associated with the hardware and software, Killian describes pedagogical and psychological barriers. Included are concerns that the ***net is a place where students may be adversely influenced by undesirable elements*** as well as unsettling issues associated with ***a curriculum that is increasingly more student defined and less controlled by the teacher***.

Insight into barriers and solutions is also contained in the CoSN-FARnet Report. (1994) As well as addressing already mentioned barriers, the authors pointed out the need to provide students with time and opportunities to explore and to become competent so that they could instruct others. Teachers need to become more motivated to change why and what they teach. This begins to get into the area of educational reform on all levels of the schools. Ignoring the potential of the internet in this area can cause problems when values associated with technologies clash with values of the schools. This is even more strongly addressed in the paper on technology refusal by Steven Hodas. (see Hodas, 1993) Jamie McKenzie (see McKenzie, 1994) deals with specific suggestions in his very positive paper that answers the Hodas issues.

As if these issues were not enough, still others can be identified when dealing with evaluation and quality of projects. Lieberman and McLaughlin (1992, pp. 63-67) also introduce issues dealing with stability with typical network funding covers start-up costs, but when that phase is over, the networks and participants often need to seek funding from agencies whose goals and personnel may be different. This may mean that the job of justifying the technology begins all over again. Other issues surrounding evolving goals and control are mentioned as well. While some of these issues seem to be unrelated to the startup problems many of us face or would like to face, successful integration of new technologies requires monitoring of the various phases that the institution and the technology pass through together.

Access issues are obviously a problem when considering the powerful tools that networking can bring into play. Many of us are struggling to overcome these problems so that we can begin to progress.

Another issue that many feel is as important is that of gender inequity in technology education. Rice (1994, p. 2) states "The use of technology must be integrated into classroom practice to effectively prepare students for the global economy of the 21st Century. Research suggests that there is a dramatic need for inservice and preservice professional development opportunities for K-12 teachers in science, math, and technology, the majority of whom are women. Moreover, achieving this goal requires recognizing that a gender effect exists and adopting strategies to attain gender equity in the classroom." Without understanding how educators can unconsciously perpetuate gender bias in the traditional science, math and technology areas, we can effectively deny a significant number of students opportunities we worked so hard to provide. Since networking has the potential of being one of the more valuable tools for educators and students, and since it is applicable in all grade levels, building specific activities into regular inservice that deals with gender biasing will help prevent inequities from developing. Sensitivity to the subtle nature of this effect will aid in understanding some reluctance to utilize computerized technology among students and teachers alike.

Among other authors dealing with barriers surrounding successful use of computerized telecommunications, Rice identified other areas that may not be so evident to those so focused on obtaining access and training. She mentions the need for educators to develop various techniques of dealing with Oregon's school reform endeavors. It is to be expected that many educators do not have a shared vision of schooling and of the role that telecommunications can play to develop resources for instructors and experiences for the students that will provide the changing student with what is needed for today's world. Ignoring the potential of computerized telecommunications in the area of school reform is to handicap ourselves at instructors and guides and create one more reason for the failure of this technology. This is not limited to Oregon's educators, because many are feeling the pressures of changing students and changing needs that are not being met with current, outdated technologies. The ability to make walls dissolve inside buildings and between schools and countries allows us to access information as it develops. If this is underutilized, then we are doomed to be always under prepared for rapid and necessary change.

CONCLUSION

A final note regarding barriers to the successful utilization for computerized telecommunications should identify one other barrier. Since the aim of this paper was to identify barriers to using this technology, and since so much of Oregon is simply lacking access, it would be easy to stop here. Simply providing access and skills needed to survive a couple of years with this technology, even with good inservice on a regular basis and parental support and involvement is not enough. Failure to become familiar with the works cited in this report and others in the detail and perspective they provide is in and of itself a serious barrier to continued success. Failure to understand the implications of school reform, the empowerment of teachers and the necessity to examine our very antiquated technology, Education in America, is to almost guarantee that change will take place without our having a significant say in it. The potential of utilizing computerized telecommunications for the effective changes demanded soon is not to be underestimated. Never before have we had the opportunity to converse with one another and share the collective experiences, knowledge and wisdom so rapidly. Many of the works mentioned here and others abound in ideas to overcome these and other barriers.

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BENCHMARK REPORT 5: How Does Using Computerized Telecommunications related to educational Reform in Oregon, Nationally, and Internationally?

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**If we always do what we've always done,
we will always get what we've always gotten.**

Computerized Telecommunications (CT) takes several different forms. These forms range from passive to active to competitive. They can involve students as individuals, small groups or entire classes and collaborative groups of many, world wide classrooms. The nature of the activity determines the scope of the involvement.

One method of classifying the types of activities for science and mathematics is by the nature of the activity and the scope of the involvement. There are passive and active activities. These activities can be done by individuals or in collaborative groups.

A passive, information retrieval activity would involve similar tasks found in a traditional library. The student or group of students would be assigned a topic to research and would perform the research sitting at a computer searching the world, instead of perusing the stacks at the nearest available library.

These information gathering activities could be done using a relatively local access system such as the Portland Area Library System (PORTALS). They could be done as national search using the Library of Congress, the NASA archives, the Argonne National Laboratory and the American Mathematics Society, The research could be done using all of these plus international access to places as diverse as the Vatican Archives or the University of New South Wales all without leaving the classroom.

An active task could be a program of observations or research carried out by individuals or groups at similar or different locations. A classroom in Estonia is looking for observations of seasonal changes around the world and exchanging data with other classes. Some classes are gathering information about wildlife and habitat conservation projects as diversified as wetlands preservation in northern California or Save the Horny Toads in the Texas desert. One classroom in New South Wales Australia is gathering information about the methods used by different cities and societies to handle their trash, sewerage, and recycling. A Mendocino, CA classroom is seeking to arrange the exchange of "Environmental Boxes" with classes outside the United States.

Many of the projects seek to collect the data and acknowledge the participation of others in their search. Other groups plan to organize and disseminate the information to all interested parties once the correlation and organization is complete. The variety of the projects is limited only by the imagination of the authors and participants.

Another type of active task is the "Ask the Scientist" programs found at different sites around the world. Portland State University has developed a program that allows students to ask a geologist questions. The Chicago area has "Ask a Scientist" resources for many branches of science, mathematics and engineering. NASA has provisions for answering questions about many of their own projects and services.

MathMagic, Com-partida de Matematica (CPM) (Mathematics to Share), EUSEMA - Europe E-mail Seminar from Mathematics, and Math Olympiad are a few of the active mathematic "competitions" found all around the world. Some of these competitions are individual in nature, others are collaborative, and many feature both kinds of events.

"The Oregon Educational Act for the 12st Century:

Declares that a restructured educational system is necessary to achieve the states goal of having the best educated citizens in the nation by the year 2000 and a work force equal to any in the world by the year 2010.

Requires schools to develop student skills in reading, writing, information retrieval, problem solving, ... critical thinking, and working alone and as part of a group. ... ensure student knowledge of ... advanced mathematics and sciences ...

Sets education performance standards for all students called the Certificate of Initial Mastery ... and Certificate of Advanced Mastery ... benchmarked to the highest in the world."(Note 2)

These general reform guidelines as related to science and mathematics are specified in these excerpts from the CIM/CAM outcomes.

Apply Science and Math - Apply science and math concepts and processes, showing and understanding of how they affect our world.(Note 2)

CT could be one of the most significant tools for the teaching of science and math ever invented. We will have almost instantaneous access to the most current scientific work being done every where on the planet. We will be able to bring the most current and pressing problems and issues directly to our classrooms for our students to work with. The students will be able to work with the tools of science and math directly on the problems that face us now. We will be able to deliver curricular relevancy in large doses immediately.

Use Technology - Use current technology, including computers to process information and produce high quality results.(Note 2)

There is no better instrument available to process information or produce high quality results than a computer. If what you are trying to communicate can be done visually or auditorially it can be done on a computer in a superior fashion. When I think of what kind of science or math projects could be done utilizing CT and multimedia I tend to go into overload.

Quantify - Recognize, process and communicate quantitative relationships.(Note 2)

In science and mathematics we are taught to observe, record, measure and otherwise define what we observe. The use of CT to communicate these observations to others for either information or utilzation as part of a larger whole would give our students the same kind of experiences we take for granted as scientists and mathematicians.

Self-Direct Learning - Direct his or her own learning, including planning and carrying out complex projects.(Note 2)

If the concepts and processes in science and math are the most important part then the actual content is not as critical as we were taught and are teaching. The learner can achieve mastery of the science and math concepts and processes using a much wider variety of content of content vehicles of their own choosing using CT.

Collaborate - Participate as a member of a team... including working well with others from diverse backgrounds.(Note 2)

Utilizing CT the members of a team need not be in the same classroom or building. The members of a team collaborating on a project can easily be on different continents. The only barriers may be the time of day and languages involved. As to working with others of diverse backgrounds, the computer knows nothing about gender, race, age, color, natural origin and cares even less.

Think - Think critically, creatively and reflectively in making decisions and solving problems.(Note 2)

In order to gather information using CT a student must be able to define the problem clearly in their own mind before attempting to gather information. While surfing the InterNet is great fun, it is a very unproductive way to do research. With the sheer volume of information and the massive number of storage sites on the InterNet, the students will have to be able to utilize some of the higher order thinking skills just to be able to locate the sources for their research. With a much wider, more diverse audience, there will be more chance for our students to exchange views about controversial topics. Faced with the need to articulate their views "on paper", with the prospect if immediate review by an audience of their peers, students will need to be able to think and reason clearly and concisely.

Communicate ... through an integrated use of visual forms... (Note 2)

If it's in a book it's out of date. If you find it on the net, it is not nearly as out of date. Communication is what CT is all about. Shared science and math is the best science and math. Students love to share what they have learned or created. Using CT we have the capability of instantaneous , world-wide publication of the projects the students submit. With this kind of potential audience the students will want to be producing high quality work.

GOALS 2000: EDUCATE AMERICA ACT

In passing the Goals 2000 legislation, the Congress declares that the National Education Goals for mathematics and science are the following:

> By the year 2000, United States students will be first in the world in mathematics and science achievement. The objectives for this goal are that... Mathematics and science education, including the metric system of measurement, will be strengthened throughout the system, especially in the early grades; The number of United States undergraduate and

> graduate students, especially women and minorities, who complete degrees in mathematics, science, and engineering will increase significantly."(Note 3)

In an excerpt from America 2000's Four-Part Strategy, part one stated that the schools of the future need to be better and more accountable schools with world class standards incorporating both knowledge and skills. Part two specifies that communities create a new generation of American schools that will reach toward these world class standards. In part three, the rest of us, todays work force/yesterdays students, are tasked with establishing job related skill standards built around core proficiencies. Part four is a challenge for the communities of our nation to adopt the six national educational goals and develop report cards for measuring the progress made toward attaining these goals.

The CIM/CAM program outlined in The Oregon Educational Act for the 21st Century, with its benchmarks at grades three, five, eight and ten, parallels and reinforces these guidelines. The use of CT could be an integral part of being able to produce this new generation of American schools. We cannot produce a new generation of workers using techniques basically unchanged since our grandfather's time.

The Secretaries Commission on Achieving Necessary Skills was asked to examine the demands of the workplace and whether young people are capable of meeting these demands. The Commission was charged with defining the skills necessary for employment, proposing acceptable levels of proficiency, suggesting effective ways to assess proficiency and developing a dissemination strategy for the nations schools, businesses and homes.

The Secretaries Commission on Achieving Necessary Skills Report (SCANS Report), published in June, 1991 listed five competencies, and a three-part foundation that are essential to job performance.

The five competencies are:

Resources: Identifies, organizes, plans and allocates resources (Time, money, material and facilities, human resources)

Interpersonal: Works with others (Participates as a member of a team, Teaches others new skills, serves clients/customers, exercises leadership, negotiates, works with diversity)

Information: Acquires and uses information (Acquires and evaluates information, organizes and maintains information, interprets and communicates information, uses computers to process information)

Systems: Understands complex interrelationships (Understands systems, monitors and corrects performance, improves or designs systems)

Technology: Works with a variety of technologies (Selects technology, applies technology to task, maintains and trouble shoots equipment)(Note 4)

In order to do research using CT one must have, or be developing knowledge of, these five competencies. All five are skills that can be further developed and applied using CT projects. When working with other students in different parts of the world on problems related to mathematics and science, management of time and resources, the ability to work well with others, and an understanding of how a system like the Internet works would be vital to the success of a project. Without at least a basal knowledge of how to aquire information using a system as complex as the Internet, the projects would never get started much less completed.

The three-part foundation of skills and personal qualities is:

Basic Skills: Reads, writes, performs arithmetic and mathematical operations, listens and speaks.
Thinking Skills: Thinks creatively, makes decisions solves problems, visualizes, knows how to learn, and reasons.

Personal Qualities: Displays responsibility, self-esteem, sociability, self management, and integrity and honesty.(Note 4)

Without these qualities, the students of today and workers of tomorrow are in for a very difficult time. In order to utilize CT one must have basic reading and writing skills. In order to locate the resources necessary to complete a task a student must be prepared to think in a , complex, global fashion. They must be able to at least visualize what they are doing for it to become real to them. When engaged in CT kinds of collaborative projects the personal qualities have the most chance to develop. If you have ever tried to teach some of these qualities you know they are easier to learn than they are to teach.

There have been some major shifts in education over the last few years. Some of these are as follows

From:	To:
Whole class instruction	Small group instruction
Lecture and recitation	Coaching
Teaching the better students	Teaching the weaker students
Isolated passive students	More engaged, involved students
Test based assessments	Progress, product and effort based assessments
Competitive social structure	Cooperative social structure
All learning the same thing	All learning different things
Primacy of verbal thinking	The integration of visual and verbal thinking"(Note 5)

The "From" side represents the way most of us were taught and many of us have taught for years. The "to" side represents the new trends in teaching students to be able to survive and thrive in the new workplace. By working with smaller groups at a time we will be able to put our best teaching efforts where we can do the most good. We will be able to engage our students more fully in the business of learning by having them choose what content they wish to use as the vehicle to aquire new skills. It is said that it is not how smart you are, but how you are smart. CT can give each student a chance to be smart in their own way.

Notes

1) These projects were gleaned from gophers and WWW sites around the nation and world.

2) Taken from a summary of the Oregon Educational Act for the 21st Century: HB 3565

3) Taken from various summaries of the Goals 2000: Educate America Act found in the Eisenhower Clearinghouse gopher.

4) Taken from a SCANS Report summary provided by the Teri Pavlonnis, Curriculum Director, North Clackamas School District

5) Braun, Ludwig, TEST Final Report

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BENCHMARK REPORT 6: How are educational professionals and others currently being trained to use computerized telecommunications?

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INTRODUCTION

In 1991, rural science and mathematics teachers gathered at an annual conference to learn about new ideas for their classrooms. The materials and demonstrations at the conference were arranged around a high technology theme--everything from robotics to computer telecommunications was displayed. One science teacher we know, we shall call him Denny, offered some very negative feedback about the information and opportunities of the conference: What relevance does all this stuff have for me in my school? We don't even have a computer or a phone line. This does me no good at all!

In 1993, a similar meeting of teachers was held. One presentation was made by a teacher who showed others how to use a cellular telephone and portable computer interface to access the Internet. The teacher showed how to access, manipulate and retrieve information with the ease of a professional. The presentation was accepted in amazement because the teacher demonstrated how his students were able to access databases and materials for their independent projects from a remote, rural town in Oregon. The irony in this was that the teacher was Denny--the same one that had been so critical of high technology only two and one-half years before. Denny was in the fast lane of the information super highway!

What incredible transition had taken place in this professional to move so quickly from complete revulsion to elation in regards to technology and computer telecommunications? How did this educator gain an appreciation for the technology? How did he gain the skills needed to learn how to access this technology? And, how did he learn how to negotiate and apply the information highway for classroom use? This paper is organized around those three questions: 1) Current methods employed in attracting and educating professionals about the potentials for use of computer mediated telecommunications, 2) Current methods employed at helping professionals learn the technological skills necessary for computer facilitated telecommunications, and, 3) current efforts to help professionals to learn to apply the resources available through telecommunications to instructional aims.

AWARENESS

To begin explorations about current efforts to train educational professionals about the use of telecommunications, we must first begin with the basic question of awareness. The first step in any educational process of change is to get the attention of the learner. Where did Denny acquire an interest to pursue technology and computer telecommunications? To answer this question we conducted an informal survey of 20 educational professionals currently using telecommunications in their work to find out how they became aware of the potential in this area. We asked, "What factors led you to think that technology might be a worthwhile application to pursue?" (See End note). Table 1 displays the results of this informal poll.

Table 1. Results of Sample Survey: Source of Developed Interest in Technology

Source of Information	Percent of Respondents
Educational Conference Presentation	30%
Workshop or Inservice Opportunities	25%
Personal Contact with User	15%
Journal Article, Book or other Literature	5%
Pre-service	15%
Other, Combination of, or undefined sources	10%

From these data and other anecdotal sources it can be determined that there are several important methods operational in apprising professionals about the utility and the usability of computer mediated telecommunications. An example of each of these sources may clarify the mechanisms of communication and early education. Educational conferences are effective ways of disseminating new ideas and information. Sessions that are informative, demonstrative and meaningful provide teachers with enough initial interest to provide a stimulus for further opportunities for learning (Hansen, 1994). Pat, a resource teacher, reported that she "saw all kinds of wonderful applications of the use of telecommunications at the National Association Science Teachers conference." She wanted to "find out how my school might be able to get access to the same kinds of things I saw like Kid-Net and Kid-link." She had confidence in what she saw because the session was delivered by a teacher just like herself using the technology to enhance curriculum in the classroom. The conference had been the first real opportunity for her to see how telecommunications could be of value. For many, educational conferences may be a vital first place where technology education begins.

Some educational professionals have entered into an understanding and appreciation of telecommunications through a formal inservice opportunity. Workshops put on by state departments of education, schools of higher education , and local agencies have done much to pre-educate about the use of technology. Bill, a social studies educator from Ontario, reluctantly attended a workshop in technology as part of a school reform initiative. The workshop was delivered by a regional college and featured a range of technological applications of the classroom. All seemed fairly irrelevant to Bill until the instructor demonstrated the Internet gopher. Bill was dumbfounded when in a few keystrokes the instructor brought up an information database directly from Russia. "I can't believe it was so simple to reach out and get information like that! I could think of a hundred uses of this kind of thing." From this one experience, Bill has pushed to try to get his school connected to a local Internet node.

There are cautions in expecting that this first encounter with telecommunications in an educational conference or workshop will be positive for all teachers. In several instances, formal experiences only succeeded in alienating prospective learners by making the presentation too flashy, too technical, or too preachy (Hawkins, 1994). The age-old perspective of pushing every teacher through an awareness inservice two days before school starts is not an effective way of changing behaviors (Hurst, 1994). Effective strategies in helping educators have a first-hand and positive look at telecommunications is in offering simple, doable exercises that offer new ideas and opportunities for learners.

Hawkins (1994) recommends several successful aspects of first encounters:

- Use the technology to serve educators' stated interests.
- Use educators' prior knowledge to plan for further instruction.
- Limit the exploration to one or two new ideas.
- Provide time for practice and direct manipulation of materials.

Even well designed hands-on experiences are not insurances for ultimate adoption, however. William Ritz (Ritz, 1994) reported that science teacher educators that attended a well-developed workshop in telecommunications demonstrated much less interest than those who had been given a presentation that paled by comparison. There seems to be no real formula or guarantee that any particular inservice will provide the expected results. The results of the informal study indicate that personal contacts were the most critical in shaping an attitude towards technology and telecommunications.

There are examples that are compelling and that provide an intuitive argument for this kind of education. Ken, a science teacher and technological whiz, regularly downloads information from ftp sites all over the world. He recently downloaded a very large HyperCard stack from a NASA ftp, unpacked it, and showed it to a colleague, Barry, an earth science teacher. After playing with the information stack of space photos of earth, Barry said, "Where did you get this? How did you do this? How can I do this?" Barry was hooked. The personal, relevant and timely contact was an effective way for the teacher to see the possibilities and the need for further learning.

Certain types of literature can be a way to attract users to technology and telecommunications. One principal, Gary, reported that he had gained an insight about technology from a recent issue of Educational Leadership (Clovis, 1994). From the article he had read how a teacher frustrated with finding curriculum and pedagogical resources for a Peruvian student accessed the Internet and found a world of resources at her fingertips. Gary wanted to know more about how this information highway worked and how he might get his teachers on it.

Colleges of education are just beginning to formalize ways to help teacher candidates see the value in technology and telecommunications. Teacher education graduates from one Oregon college are brought through a learning experience in curriculum where telecommunications are used to provide on-line information not available in any other format. Kelly, a secondary science educator working on a genetics unit for her class was delighted to receive a copy of a gene simulation game from an ftp archive. "You mean this stuff is free?" Kelly asked in amazement. She saw the need to learn more.

All of these early methods of attracting educators to the notion of using technology and telecommunications seem critical. Marketing professionals who study communications and human behavior often cite a well known bromide that seems to apply here: In order to get people to do something you want them to do, they must see or hear your message three times. Advertisers place ads on radio and newspapers, use flyers and posters, and depend upon word of mouth to enliven interest in the event. Perhaps this advice is relevant to current methods to attract education professionals to technology and telecommunications. Successful methods may need to employ a variety of tools that communicate the potential of computer facilitated telecommunications for educational purposes.

INITIAL SKILLS

Once a person finds the need to pursue technology and telecommunications, what methods are currently utilized? The same individuals that were cited in the aforementioned study were asked the question, "How did you attain the skills you currently have in telecommunications technology?" The results of this inquiry are summarized in Table 2, found on the next page.

By far, individuals with skills in technological telecommunications have arrived at these skills through much trial and error. Pat reported that after she gained the interest to learn telecommunications that she just tried it. There were many initial barriers to understanding, but by trying all sorts of things Pat had acquired a practical education. Trial and error seems to be the way in which the first wave of educators has learned this technology. Since few organized resources are available at any start-up, individuals explore systems and discover how things operate.

Table 2. Results of Sample Survey: Method of Telecommunications Skill Acquisition

Method	Percent of Respondents
Formal Class or Workshop	15%
Tutorial	15%
Trial and Error	40%
Mentoring	20%
Other, Combination of, or undefined sources	10%

At the higher education level, faculty at an Oregon institution were given an electronic information exchange system EIES2 and access to Unix and Internet with almost no practical experience or documented help. These faculty learned how to manipulate the system by trying first one thing then another. Learning in this way is related to the overall inquisitiveness of the user. Some faculty are able only to send and receive Email, use teleconferences and access simple gopher applications. For others, nuances of uploading, downloading and decoding, ftp, list serves, and systems shortcuts are still buzzwords. Clearly, trial and error learning is idiosyncratic and ranges from highly skilled users to those who have little ability to negotiate and use the the fullest potential of the systems available.

Learning how to use telecommunications in a very direct and hands-on way has also been the focus of formal classroom teaching methods. Typical of this method are formal training sessions where educators sit at terminals and follow instructions from a leader or from a written set of step-by-step instructions. An example of this is how pre-service teachers are trained to use the EIES2 teleconferencing system at Eastern Oregon State College (Lund, 1994). Teacher candidates are arranged in groups and are taken though a hands-on experience with telecommunications in a one-day workshop presentation. Students are given exercises on how to login, use passwords, how to access the teleconference, how to send and reply to mail and how to interact with conferences. Students leave the workshop with rudimentary practice using the technology and with printed materials, software and instructional videotape of the information and skills covered in the workshop.

Those who report that they learned much from the formal training also reported that when faced with applying their skills and knowledge to their own circumstances, that they had to relearn how to do all basic operations such as: connecting peripheral devices and modems, learning new software protocols, initializing strings for modems, and learning unique and idiosyncratic operational procedures for remote sites. Learning how to negotiate technology and telecommunications through formal workshop succeeded in informing educators about the purposes and techniques of communication, but has been ineffective in helping solve individual needs of users.

Individual needs appear to be solved by individuals. Several respondents to the survey applauded the efforts of individuals in helping them solve particular problems that can only be characterized as idiosyncratic. Several short examples demonstrate how this kind of instruction takes place. Tim, an elementary teacher and an avid technology advocate, was hired by the Union/Wallowa/Baker Eisenhower Consortium to help science and mathematics teachers learn how to use telecommunications. In 1993, Tim had assisted individual teachers with their computers, modems and software and had mentored them through the initial steps of learning. Tim has taught educators how to allay simple problems such as: how one must press the return key after the password prompt, how to replace a set-up string so that the modem will respond, and how to set-up software so that telecommunications parameters are appropriate. This mentoring relationship between one professional and another has successfully engaged a high proportion of users in Union County, Oregon. These one-on-one relationships are the most effective way of communicating the varied aspects of technical skills involved in telecommunications (Hansen, 1994).

Tutorial has been another way that educators learn how tonegotiate the information highway. Several different sources were cited by individuals that were helpful in learning specific routes and processes. INTERNET: Getting Started (Marine, et al, 1993) and Internet Companion (LaQuey & Ryer, 1993) are two tutorial examples that have helped individuals learn how to accomplish certain tasks. Still, respondents were cautious in pointing to one source of written materials as the only method of gaining skills in telecommunications. Tutorials and texts typically are written with a wide audience in mind and may lean to a family of computer software or another. Some tutorials are now constructed for specific kinds of learning. Eastern Oregon State College in La Grande offers college students a comprehensive tutorial guide for learning how to use a teleconferencing system (Awakening Technology, 1992). The problem with any tutorial, however, is the relative short duration that the information can be expected to remain accurate. As systems are upgraded and as software is changed, printed information is less likely to accommodate these changes and learners are apt to be frustrated when a computer screen and a tutorial page do not match.

Clearly, current efforts to help professional learn how to turn-on and tie-into telecommunications resources are varied. It is important to note that in almost every case of a personal history of learning that there was more than one thing active in bringing a person to proficiency. In some cases, teachers trained through a one-shot experience learned basic ideas about telecommunications, but when they retuned to their own computer, the generalized information was difficult to transfer.

Organized instruction, printed tutorial, and mentoring appear to have the greatest effect when offered in logical conjunction with one another. For example, teacher candidates were first given a formal workshop with operational vocabulary, rationale and purpose and hands-on practice with computers and teleconferencing. This was followed by written, software, and video back-up materials that the students could refer to on site. When students began to initialize their own systems in remote sites, technicians were available to ask questions and to trouble shoot problems. Successful efforts in telecommunications training appear to use multiple modalities in assuring ownership and understanding of systems and processes.

DEVELOPING APPLICATIONS

The last important aspect of helping professionals use technology and telecommunications is one of applications for use. Research from a previous decade of training in the development and applications of computer use in the classroom found that merely providing technical expertise was short of the goal. Without a clear understanding of educationally beneficial uses, it is unlikely that administrators and decision makers will be willing to dedicate scarce resources to making the Internet available.(Maddux, 1994) Computer telecommunications is unlike learning how to use a piece of applications software or some other tool of technology because there is no specific utility that we can point to. The very nature of the eclectic resources available through the Internet and teleconferencing require a third level of learning: How can an educational professional learn how to use telecommunications as a resource for learning?

Again, we asked our respondents to comment about this area. "How do you use computer telecommunications in your profession and how did you determine that application?" The results of this query were as varied as the respondents. Each individual had something very different to say about the application they were involved with. A sample list of uses ranged from simple to sophisticated: Email to communicate with other teachers, ftp to download application software to enhance learning in the classroom, Gopher searches to find resources for student projects, Use Net or list serves to find professionals with similar interests or to share information with others, and teleconferencing to plan or discuss collaborative projects. Although applications ranged widely, how educators learned that these applications were possible was more distillable. Table 3 lists the variety of responses that demonstrate how educators have learned about applications of telecommunications.

Based upon the responses of those who use computer telecommunications as an adjunct of their profession, it appears that there are a variety of successful ways of acquiring this information. Once an educator has learned the what and the how of telecommunications, further learning seems more portable and possible. Alerted to the possibilities, users who have a concept of how systems work can easily add new applications to their repertoire. There are a few specific examples that deserve some attention of how educators have added to their understanding of applications. Institutions that have personnel assigned to the task of technology education often perform the function of moving educators from knowledge and skill to application. Although a risky financial venture for most smaller school district and institutions, these

Table 3. Results of Sample Survey: Source of Learning about Telecommunications Applications

Source	Percent of Respondents

Formal Class or Workshop	5%
Technical Literature	20%
Teleconference	5%
Consultant/ESD or School District Curriculum Coordinator	5%
Trial and Error	35%
Mentoring (Word of Mouth)	15%
Educational Conference	5%
Other, Combination of, or undefined sources	10%

personnel can be active stimuli for educators to learn how to apply their skills in the classroom. (Pearson, 1994). This ongoing source of information and encouragement in the form of a full time specialist appears to work in small school districts to stimulate active participation in technology. Technological consultants have been used in a significant effort in Texas to help teachers, students, parents and university students learn how to negotiate high technology (Curtin, et al. 1994). Meeting with small groups over relatively short periods of time, consultants helped individuals with personal technological needs. The results of these specialized learning sessions were dramatic. Educators and children in the study now use technology in everyday tasks.

Special curriculum projects such as TERC (Ruopp, R. et al., 1993) are back door opportunities for educators to learn more about telecommunications applications. As Pawoski (1993) writes about his experience with a curriculum project, "In order to support the Wetlands Project--a new distance learning effort--I needed to learn all about the Internet." The interest in the curriculum project itself demanded the acquisition of new information and skills. Educators are brought into learning about telecommunications because they are keenly interested in the information or materials that are available.

Such is the case with student teachers in Long Beach, California (Ritz, 1994). Placed in a wide metropolitan region, each is loaned a computer, modem and training in teleconferencing. Each student is required to submit lesson plans, schedules and other information to the supervising college faculty member. The college faculty responds and communicates suggestions about lessons back to the student teacher. In other situations, college courses that use teleconferencing as a primary tool for course delivery and discussion require that students learn how to use the technology when they enroll. Students learn how to negotiate these networks out of tension of need. In many cases, the ways in which they have learned depended upon collaboration with other students in the programs. Instructors interested in alleviating the tension of learning a new system have leaned heavily on this information and now build collaborative groups of students making sure each group has a student that has been identified as technologically adroit.

An important addition to the aforementioned and more typical ways of learning is the advent of learning about telecommunications by using telecommunications. *Telecommunications and Information Access for Educators* a credit-bearing course offered by the University of Oregon and the International Society for Technology in Education (ISTE) has successfully tested the delivery of a wide array of information and skills in telecommunications (Schrum, 1992). There are at least three similar concurrent inservice programs offered currently which enroll thousands of participants. The purpose of these efforts is to help users learn new applications and technical operations of telecommunications.

SUMMARY

Moving educators from awareness to appropriate applications takes an eclectic tool kit of learning experience and access to technology and telecommunications. From what we have learned from models of training related to computer applications we know that expenditures for inservice training will always lag in comparison to expenditures for hardware and software. (Office of Technology Assessment, 1988). The National Education Advisory Board (National Education Advisory Board, 1993) details the status of technology and telecommunications by saying what is is not:

- Teachers are poorly prepared in technology.
- Student teachers see little technology applied in the field.
- Teacher education programs provide little technology education.
- Higher education faculty have few skills to transfer to learners.
- Colleges of education provide few opportunities for courses or inservice in technology.

Moving educators from awareness to application requires a concerted effort to reach different levels of educators. The methods that are employed will most likely first depend on effective and timely demonstrations of the use of technology and its application to solving real-world educational problems. The second wave of educators hearing or seeing the computer telecommunications story will only be moved to further interest if it offers solutions to perceived needs. If workshops, inservice programs, conferences or other first exposure is to be effective, then the information and demonstration must show how this technology will help teachers and learners forward knowledge and skills that correspond to the new goals of schooling such as the outcome-based Certificate of Initial Mastery or Certificate of advanced mastery in Oregon's reform agenda (Oregon 1989).

Once educators are informed and are engaged, opportunities for learning the technical aspects of telecommunications need to be made available in a variety of formats. Initial adventures with technology may require an intensive hands-on approach and may also need to be accompanied with personal mentoring to be effective. Individualized tutorial, texts, videos, and telecommunications courses themselves are troubled by idiosyncratic differences and often fail to inform individuals how to actually make their own personal telecommunications systems operate. After the initial foray, additional skills development can take place through a variety of media and methods. Effective use of teleconferencing and tutorial can provide learners with the tools to explore the information highway at their leisure. Efforts to help faculty at one college for example, combined an early hands-on experience with a teleconference that helped faculty discuss how to use the system while they used the system (Lund, 1993).

There is an interesting phenomena that occurs after education professionals have learned the basic concepts and skills of telecommunications. For many, there is a "So what" feeling after the initial interest and zeal wears off. It is akin to getting a video game and then losing the reinforcing nature of newness that continues to motivate the learner (Jaeger, 1988). For educators to utilize telecommunications as an effective tool, continued learning about how others have applied its use in the classroom seems essential. Developing information networks with other professionals may be the most effective long-term strategy in helping all continue learning about technology and telecommunications. Because the information on the superhighway is so volatile, an irony of learning how to use and apply sophisticated uses of telecommunications is that telecommunication itself will ultimately be called upon as a basic mode of education.

Managing future educational efforts to bring educators from awareness to sophistication will require a coordinated effort. As many have discovered, logistical plans for development and application of technology in schools require a significant effort of planning between all stake holders concerned with learning. Coordinated plans have demonstrated significant success in forwarding the use of telecommunications technologies (Durost, 1994). Such plans are arranged as outgrowths of educational needs and concerns rather than from the pressure of acquiring the technology itself. Having stated the broad outcomes of educational efforts, technological solutions are identified and outlined. Efforts in teacher training are marshaled towards the intended goals of education and the role of technology becomes a subset of a larger educational objective.

The most effective current methods of helping educators understand the utility of telecommunications are still a feeble effort. Few organized or adequately supported opportunities are available for educators to learn about telecommunications. The educators surveyed in this paper are examples of people who learned how to use technology despite the varied barriers to learning. It may be an unreasonable assumption to believe that current educational systems and opportunities will be adequate to train the next wave of science and mathematics educators interested in getting on the information superhighway.

ENDNOTE

The informal survey was conducted among 20 educational professionals representing K-6 elementary education, 8-12 science and mathematics teachers, curriculum specialists, general college faculty, state department of education specialists, and university personnel whose function was to promote telecommunications education for teachers. Personal and telephone conversations were held over a one-month period between 10-5-94 and 11-3-94.

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BENCHMARK REPORT 7: Technological/Social Trends for Computerized Telecommunications: Which Technologies and Organizations Will Best "Ride the Wave?"?

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The Fourth Millennium

Humankind has experienced three great social orderings to date: hunting and gathering, agricultural and industrial. In the first period the strongest, most skilled hunters commanded the largest territory and greatest respect. Challengers had to be stronger to take over and more skilled to remain in charge. In the agricultural era those who owned land and water rights fought off those who threatened to take over the land and water. In the third ordering those who owned the means of industrial production were confronted with the demands of laborers for better pay and working conditions.

As early as 1950 scholars and scientists perceived that humankind is entering a fourth era. Beginning with Drucker in 1959 many futurists began to use descriptive terms that had something to do with knowledge and communication. By 1980 the majority of futurists had concluded that the fourth millennium would be the information or communication society. In the new era the powerful would be those who manipulated information and the majority of problems would center on who can do what with information.

These four eras have several characteristics in common. They are global orderings; their predominant elements prevail on a worldwide scale. At the same time some parts of the world continue to operate in previous eras and some aspects of those eras continue to be required in every nation. Even though the industrial age emphasizes assembly line manufacturing, mass communication and mass consumption, humankind still needs agricultural products but the trend is to produce those products in an assembly line fashion, thus threatening the continuing existence of small farmers.

The same will be true of the information age. We will continue to need manufacturing but much of it will be done in a different way. Already, many factories are robotized and manufacturing jobs are declining as information and service jobs increase. Machlup (1962) estimated that almost one-third of the late 1950's U.S. labor force worked in the information sector, a sector that accounted for over one-quarter of the U.S. gross national product. Porat (1977) estimated that information was responsible for almost half of the GNP by the end of the 1960's and that more than half the American workforce held information jobs by the mid 1970's.

Jobs are not the only social activity that will be affected by the information age. James Beniger (1986) argues that the invention of the steam engine in the late 1700's and the resulting industrialization "brought control of the [production] system into question in the 1840's through 1880's and began a revolution in information processing and communication that continue to this day" (p. 177). The invention of the computer chip and its exponential increase in information processing capacity is causing the same kind of massive restructuring of social institutions and people's everyday activities that the steam engine precipitated. This benchmark paper reviews what the majority of futurists thinks are the most important technological and economic changes occurring at this time, evaluates what the implications of these changes, especially work alterations, are for the future of American education, and provides benchmark suggestions for accommodating these changes.

TECHNOLOGICAL CHANGE

The convergence of telecommunications and computers can be called "telematics" (after the French word "telematique" coined by Nora and Minc, 1981). A strong relationship exists between telematics development and economic development, precipitating a global trend toward establishment of largely privatized, national advanced information infrastructures. These infrastructures will have the following characteristics.

1. Hybrid systems. Various transmission technologies will be utilized: satellite, optical fiber, coaxial cable, terrestrial microwave, copper wire.
2. Digitization. Once the system carries only digitized communications transmission differences between printed text, data, voice, audio and video become a matter of bandwidth and time only. This development enables the era of multimedia.
3. Open Systems Interconnection. OSI is the internationally accepted framework for interconnecting different networks.
4. Distributed computing. Host-based will give way to network-based systems encouraging peer-to-peer networking, cooperative processing, user friendliness.
5. Convergence. Formerly separate systems will overlap in functionality and technology, e.g., television, computer (e-mail, data retrieval and processing), telephony (fax, voice) services will be offered over the same system via a multiplicity of transmission technologies.
6. Acceleration. The pace of technological change will continue to produce "transient" technologies that evolve through many generations in the space of one human generation.
7. Tetherlessness. Untethered, wireless, mobile, portable "personal communication services" (PCS) will enable users to send transmissions to anyone anywhere anytime. This development should precipitate "personal numbers" where people call people not places.
8. Broader bandwidth. New networks will emphasize broader bandwidth (mostly in urban areas and trunk lines) and better use (mainly through compression technology) of narrower bandwidth (in rural areas and wireless applications).

There are two competing visions of the U.S. National Information Infrastructure (NII): the television/telephone vision and the computer vision. The former favors set-top boxes and the emphasis is on user retrieval of centrally-offered information and entertainment products. The latter is more interactive. Users determine their own network configurations, modes of communication (e-mail through video), and information supply. The emphasis is on users being able to send as well as receive information in any form. These two visions are most likely to exist side-by-side rather than either of them prevailing. It is the computer scenario, however, that is having the most profound effect on our working and everyday activities and that is the subject of this paper.

The major technological problems still to be worked out are privacy, security, intellectual property rights and access to systems and services.

PERVASIVE SOCIAL CHANGES

In 1982 Naisbitt argued that the "informatized" society is an economic reality not just an intellectual abstraction. Informatization, like industrialization, involves basic changes in social structures, institutions and processes. It also requires different human perceptions of what society should be like. For example, mass society assumed that mass media are the central source of information in the industrial age, that they are the only vehicles for timely mass reception of information. This assumption is breaking down. The Internet configuration, for the first time in human history, permits many people to speak to many other people on a continuing basis (Robinson, 1994). The "mass" media themselves are becoming more specialized media.

Futurists generally agree that some major characteristics of informatization are:

1. Globalization. The world economy is internationalized to the point where many business people and scholars (e.g., Reich, 1992; Ohmae, 1990) are questioning the continued existence of the nation-state. Rapid transportation and instantaneous communication technologies make it possible for people know their peers in other nations as well as their neighbors next door.
2. Commoditization of information. Information is now a product and a mode of production, i.e., just as industrial corporations enabled us to mass produce manufactured and agricultural products, informatized enterprises enable us to produce material and information products.
3. Acceleration of change. In 1970 Toffler summed up the central characteristic of future people as "transience," the feeling of impermanence or temporariness. Because we move around so much now, he spoke of the "modular man," a disposable person for those who knew him perhaps well but temporarily. Naisbitt (1982) described the collapse of "information float," the amount of time information used to stay in a transmission channel. "Virtual" corporations form to

get certain tasks done or exploit specific markets and then disband and reform with different partners. Products get made "just in time" to meet demand.

4. Uncertainty and risk. The effects of rapid change fill everyone with uncertainty. For example, in 1982 eighty-four percent of full-time American employees had defined-benefit plans. Today only about half do. Life-long employment has been replaced by hopes for life-long employability (*Business Week*, 1994). The average person can expect to work at ten or more jobs over his/her lifetime and, according to Boyett and Conn (1991), every person should be prepared to be unemployed for periods of time. Corporations face equal uncertainty as they invest abroad, develop risky technologies, and restructure their organizations.
5. Fragmentation. Large corporations are breaking up into smaller business units; downsizing is forcing laid-off workers to start their own small businesses; Internet is affording small businesses the opportunity to operate internationally (Robinson, 1994). Barnet and Cavanaugh (1991) say that "most Americans will find themselves working in a small company environment by the year 2000" (p. 37).
6. Customization. Power is shifting from suppliers to consumers as competition increases and technology permits very specialized marketing, ordering and production. 7.Self-reliance. The age of the expert is giving way to one of self-reliance. Patients can access information that lets them know as much about their diseases as doctors. Horizontal communication is replacing vertical as employers realize that control of information is less important than informed employees. Workers are less protected by seniority and job descriptions and required to demonstrate their ability to add value to group activities. An important part of self-reliance is that employers should provide life-long opportunities for workers to improve their skills.
8. Elitism. The job market is dividing in two. The few manufacturing and rapidly increasing service jobs require repetitive activities and pay low wages. The growing number of knowledge jobs (by the year 2000 seventy to eighty percent of the U.S. workforce) pay higher wages and demand creativity and analytical skills (see Handy, 1994). Knowledge workers marry other knowledge workers and their combined income puts them in the upper tax brackets. Service workers marry

service workers and have little hope of ever improving their economic standing. Good students in poor schools are taken out of that context and leave the community. Thus, we are becoming a meritocracy and a divided society.

CHANGING WORK PROCESSES

Intensified international competition requires lean and mean companies. Big companies no longer dominate the market because the age of mass consumerism is gone. Consumers now demand unique products for their unique tastes and needs and they will buy them from any producers worldwide. Companies need to figure out what customers want in different locations and circumstances (Ohmae, 1990).

Small-is-better thinking has led large companies to break up and provide more autonomy to "localized" units where the targeted customers are. Rationalized companies retain only a tiny core of full-time employees, contract as much work as possible, and/or hire part-time workers according to need. The assembly line is being abandoned in favor of more craft-like work teams that take charge of a project from beginning to end. Many middle managers are eliminated, workers are given more autonomy, and horizontal, multi-directional communication permits executives to know what teams are doing at the same time as team members.

Information age technology enables this new kind of work because much of it can be done by telecommuting. Consequently, a number of companies are now doing away with individual workers' office facilities and simply assigning temporary desks to people who check into the company's building once or twice a week. The workers' private "offices" are contained in their laptop computers which they can use anywhere.

Hammer and Champy (1993) say that successful corporate reengineering has the following results:

1. Workers are more empowered and less controlled.
2. Job preparation is changing from training to education.
3. Performance evaluation depends less on activity and traditional advancement steps and more on results.
4. Advancement focuses less on performance and more on ability.
5. Protection is valued less than production.

6. Group managers act as coaches not supervisors.
7. A flat structure replaces hierarchical organization.
8. Executives emphasize leadership rather than scorekeeping.
9. Information technology is the enabler of these changes.

Critics of these changes point out that employers are making their few remaining employees work much harder, shifting facility costs to workers' homes, saving additional money at the expense of workers' jobs and retirement security, and guaranteeing a divided meritocracy. Other commenters reply that even if these charges are valid they do not matter in an age of intense international competition. If employers do not do these things, they will no longer be employers.

EDUCATIONAL CHANGES

U.S. industrial age assembly lines were developed according to the dictates of Frederick Taylor's scientific management system, a system that produced disciplined laborers and the world's highest proportion of bureaucratics/managers to workers. The educational system fed into this arrangement. Efficient teachers, closely supervised by a large administrative structure, trained students to be obedient employees. Marshall and Tucker (1992) say the result was an anti-intellectual emphasis on basic skill mastery. However, they share the belief that the educational system must prepare people for employment. They advise that "the key to productivity and competitiveness" today lies in "our capacity to use highly educated and trained people to maximum advantage in the workplace."

Even if we do not assume that the primary function of education is to train future workers, we still must acknowledge that basic economic survival depends upon a suitably skilled workforce. Given that recognition, what do the changes enumerated above imply for information age education?

Robert Reich, now Secretary of Labor in the Clinton Administration, says (1992) that we must train our young people to be "symbolic-analysts." Lester Thurow (1992) tells us that if the U.S. is to improve productivity and justify high wages, it must have an improved educational system that includes a German-style apprentice system for those not planning on college, raise teachers' wages and require them to work longer hours per day and more days per year, and persuade parents to require their children to work harder. *Business Week* recently (October 17, 1994) carried a large advertising section in which industry leaders described various ways business leaders can help improve the educational system: direct donations to programs of their choice, equipment and network donations, special training programs for teachers, teaching or assisting in classes, apprenticeship programs, mentoring and tutoring, recognizing and rewarding good teachers, sponsoring joint industry-education projects, and acting as an advocate for educational reform.

In sum, a ground-swell of opinion urges that industry work hand-in-hand with education to meet the work demands of the new era. The U.S. Congress, in recognition of this industry demand for a new kind of education for a new kind of worker, has passed a number of education bills to speed up the process of educational reform. Indeed reform seems inevitable if only because of three momentous changes that are occurring within the educational system itself: economic restructuring, new educational needs, and implementation of multimedia.

At the end of the 20th Century public schools are less supported by taxes and forced to depend more upon their own entrepreneurial skills, grants from federal agencies and industrial sources, and, in the case of post-secondary institutions, higher tuition. Declining support is prompting an ever-widening array of institutional configurations: privately managed public schools, charter schools (local schools designed by community leaders, educators, and parents), university-operated schools, home schooling, and virtual schools whose facilities lie mainly in computer networks. These alternative types of schools, private schools, and traditional public schools (through arrangements such as magnet schools and vouchers) compete more and more intensely for the same community of students.

At the same time that they are feeling this financial squeeze, schools are being asked to reconsider their basic mission. The prevailing suggestions for change are to concentrate less on memorization of material and more on critical thinking skills, less on individual achievement and more on group work, less on work within an isolated institution and more on work within the real world, less on teachers as experts and more on teachers as resources, less on institutionally provided goals and resources and more on students' responsibility for their own educations, and less on "doing things right" and more on flexible application of skills. These trends are easily related to the above discussion about what information age employers want from knowledge workers.

As in the case of work, this vision of education is enabled by telematics technology. Students can work in groups with access to myriad human and data resources all over the world and they can learn through conceptualizing problems, finding relevant information, analyzing that information, formulating alternatives and coming up with solutions to real world problems. They can work cross-culturally, across national and institutional boundaries, at a distance, and they can learn from each other as well as mentors and teachers. Teachers, for that matter, can be anybody anywhere and do not have to be full-time employees of a specific school, a threatening aspect of this vision to current educators. Much school work, especially at the upper levels, can be done outside the confines of a school building with students assuming ever greater responsibility for their own educations. The concept of life-long learning fits well with the rapid change we are experiencing and the recognition that businesses need to provide opportunities for their workers to continuously improve and update their skills.

User-controlled multi-media technology can enable this kind of education because it has the following characteristics:

1. Digitized transmission of any communication mode according to the user's will.
2. User defined networks.
3. User defined information sources.
4. Horizontal communication.
5. Participatory learning.
6. Democratic learning.

The sixth characteristic is the most problematic because, yes, learning is more democratic once people are in an electronically-connected group but is it possible to provide this type of education to everyone? Thus, the major educational problem of the information age is one of access, the central determinant of the benchmarks in this paper.

The ideal educational telematics environment would be to provide every student with a notebook computer and a sufficiently wideband, digitized, integrated network to enable multimedia communication when at home or at school. This environment would enable all students, parents, teachers, and mentors to communicate with each other via multimedia anytime. Flexible learning groups could be assembled at will to work on specific problems and then disband. Evaluation would consider results rather than performance. Other social service agencies could be directly linked with parents and teachers of at-risk students.

Such an environment can be realized in steps and those steps can act as benchmarks. The Oregon Public Utility Commission conducted a workshop on Integrated Services Digital Network (ISDN) availability during the past year. The outcome of this workshop was that US West and GTE promised to offer ISDN service at reasonable rates during the coming year. The service should be available to eighty-ninety percent of the state within five years. ISDN provides multimedia transmission capability over the equivalent of two telephone lines. It can be made available anywhere and can even be offered via wireless transmission if desired or necessary (e.g., to a remote ranch).

Right now the costs of an ISDN multimedia home setup would be prohibitive to many families. Installation charges are estimated as around $400, the multimedia computer setup as approximately $2000, and the cost per month for ISDN service as $60/month flat fee (US West) or $26/month plus usage charges (GTE) for calling anywhere in a single calling area. However, these costs will descend dramatically as a critical core of users acquires ISDN service. Thus, we could reasonably utilize the following set of benchmarks:

TECHNOLOGY BENCHMARKS

1. Provide an ISDN line to every school within the state within two years. State common carriers would be required to do this.
2. Connect every classroom to that ISDN line via a classroom computer within two years. School budgets would be required to cover this cost (see cost cutting measures in #3 below). A possible supplement to school budgets could come from the Oregon Economic Development Department funds.
3. Increase the ratio of minimum multimedia capable computers to students by twenty percent each year for five years until one computer per student is achieved. This goal can be reached by putting together a coalition of Oregon's electronics and software companies to come up with a suitable computer that will cost between

$400-500, roughly one-tenth of the annual cost per student. That extra ten percent cost can be covered by not constructing new buildings, cutting down on textbook acquisition, staff cuts, and levying technology fees. Computers would be loaned to students for home as well as school use and ten percent of the budget would continue to be dedicated to computer acquisition and maintenance as well as line charges from that point on.

4. Provide wider bandwidth connections (e.g., optical fiber) as necessary to meet traffic demands generated by each school (will vary according to the number of students per school) within five years.
5. Achieve adoption of a new State of Oregon ISDN universal service to replace the old voice universal service standard within five years.

CURRICULUM BENCHMARKS

1. Phase out printed textbook use by ten percent per year for five years until half of data information retrieval is done on-line.
2. Phase out teacher delivered information by ten percent per year for five years until half of human resource information retrieval is done on-line.
3. Phase out individually oriented assignments by ten percent per year for five years until half the assignments comprise group projects.
4. Replace written test evaluation by results evaluation by the end of five years.

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APPENDIX
ONE

CHART 1

LINE COST AND CAPABILITY COMPARISON

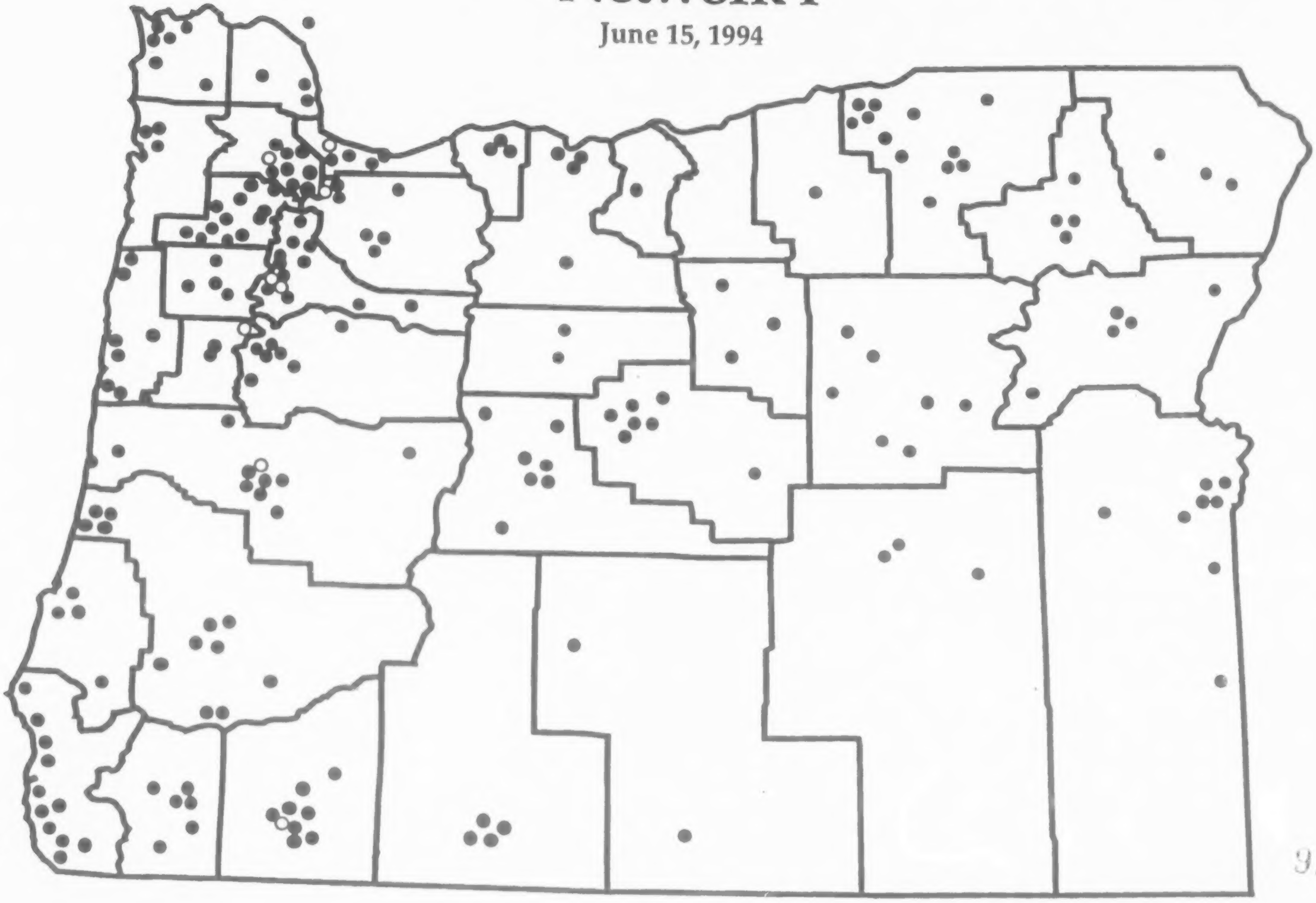
	Email Gateway	Dial Emulate	Dial Slip	Leased Slip	DSO	T1	T3	ATM/ OC3
Relative Cost - Line + net	$20	$20	$40	$100	$500	$1300	$10,000	$20,000
Bandwidth	Batch	14.4k	14.4k	14.4k	56k	1.5Mb	45Mb	155Mb
Email	yes	yes	yes	yes	yes	yes	yes	yes
Mailing Lists	yes	yes	yes	yes	yes	yes	yes	yes
Multimedia Mail	almost	almost	yes	yes	yes	yes	yes	yes
Telnet	no	yes/but	yes	yes	yes	yes	yes	yes
FTP	no	yes/but	yes	yes	yes	yes	yes	yes
Gopher	no	yes/but	yes	yes	yes	yes	yes	yes
WAIS	no	yes/but	yes	yes	yes	yes	yes	yes
WWW	no	yes/but	yes	yes	yes	yes	yes	yes
Pictures (small)	no	no	yes	yes	yes	yes	yes	yes
Batch sound	no	no	yes/but	yes	yes	yes	yes	yes
Pictures (big)	no	no	no	almost	almost	yes	yes	yes
Movies	no	no	no	almost	almost	yes	yes	yes
Live audio	no	no	no	no	almost	yes	yes	yes
Live video	no	no	no	no	no	almost	yes	yes

John Sechrest

Oregon ED-NET
Network I

June 15, 1994

CHART 2



● = **Operational Sites** (219)
○ = **Sites in Progress** (8)

CHART 3

Network II Sites

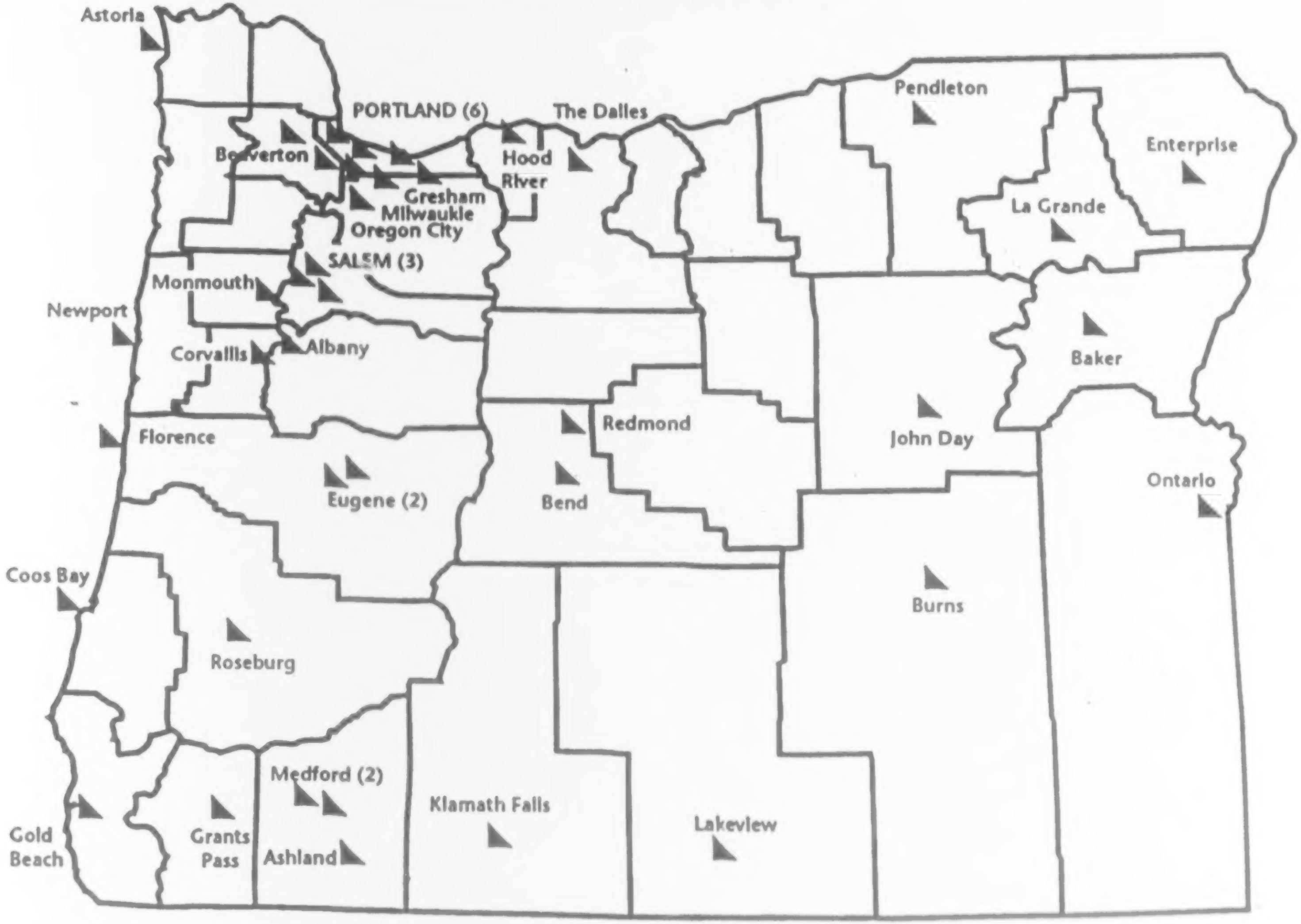
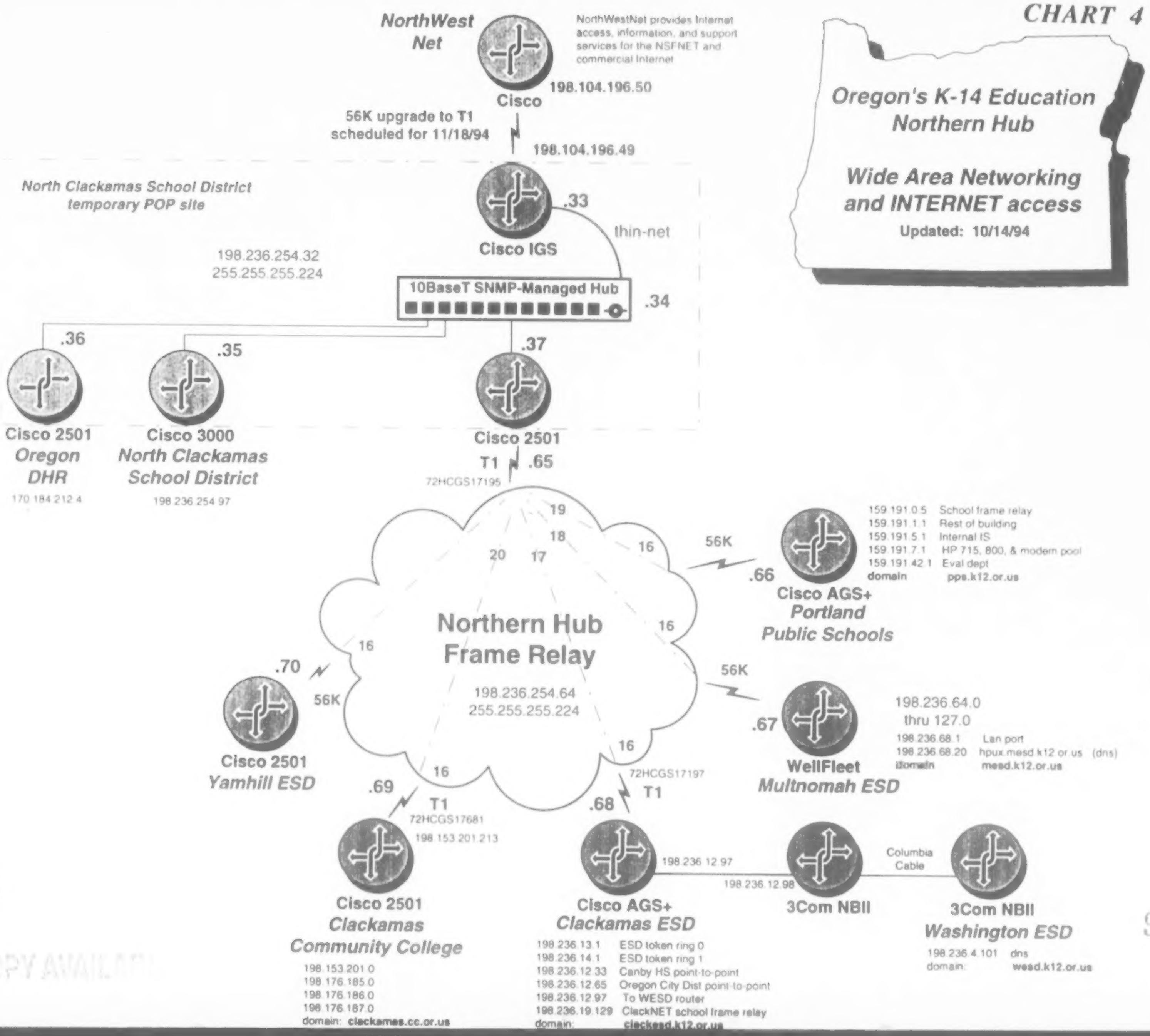

Astoria
PORTLAND (6)
The Dalles
Pendleton
Enterprise
Beaverton
Hood River
Gresham
Milwaukie
Oregon City
La Grande
SALEM (3)
Monmouth
Newport
Corvallis
Albany
Baker
Redmond
Florence
John Day
Eugene (2)
Bend
Ontario
Coos Bay
Burns
Roseburg
Medford (2)
Klamath Falls
Lakeview
Gold Beach
Grants Pass
Ashland

CHART 4



Oregon's K-14 Education Northern Hub

Wide Area Networking and INTERNET access

Updated: 10/14/94

NorthWest Net
Cisco
198.104.196.50
NorthWestNet provides Internet access, information, and support services for the NSFNET and commercial Internet
56K upgrade to T1 scheduled for 11/18/94
198.104.196.49
North Clackamas School District temporary POP site
Cisco IGS
.33
thin-net
198.236.254.32
255.255.255.224
10BaseT SNMP-Managed Hub
.34
.36
.35
.37
Cisco 2501
Oregon DHR
170.184.212.4
Cisco 3000
North Clackamas School District
198.236.254.97
Cisco 2501
T1
.65
72HCGS17195
19
18
20
17
16
16
16
16
16
16
Northern Hub Frame Relay
198.236.254.64
255.255.255.224
56K
.66
Cisco AGS+
Portland Public Schools
159.191.0.5 School frame relay
159.191.1.1 Rest of building
159.191.5.1 Internal IS
159.191.7.1 HP 715, 800, & modem pool
159.191.42.1 Eval dept
domain pps.k12.or.us
56K
.67
WellFleet
Multnomah ESD
198.236.64.0
thru 127.0
198.236.68.1 Lan port
198.236.68.20 hpux.mesd.k12.or.us (dns)
domain mesd.k12.or.us
.70
56K
Cisco 2501
Yamhill ESD
.69
T1
72HCGS17681
198.153.201.213
Cisco 2501
Clackamas Community College
198.153.201.0
198.176.185.0
198.176.186.0
198.176.187.0
domain: clackamas.cc.or.us
.68
T1
72HCGS17197
Cisco AGS+
Clackamas ESD
198.236.12.97
198.236.12.98
198.236.13.1 ESD token ring 0
198.236.14.1 ESD token ring 1
198.236.12.33 Canby HS point-to-point
198.236.12.65 Oregon City Dist point-to-point
198.236.12.97 To WESD router
198.236.19.129 ClackNET school frame relay
domain: clackesd.k12.or.us
3Com NBII
Columbia Cable
3Com NBII
Washington ESD
198.236.4.101 dns
domain: wesd.k12.or.us

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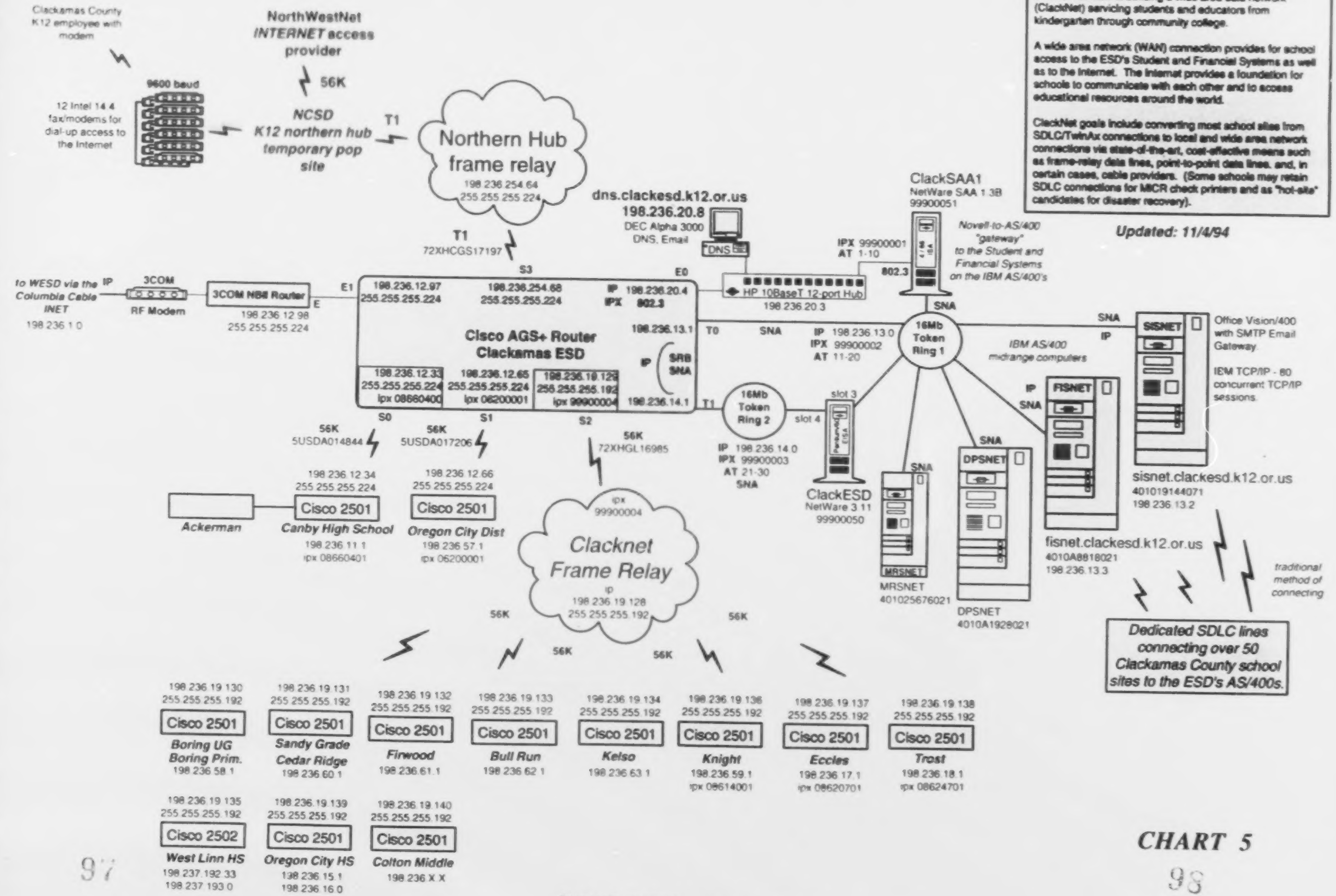
ClackNet Mission

As a member of the Oregon Public Education Network (OPEN) and as a regional leader in service to education, Clackamas ESD is building a wide area data network (ClackNet) servicing students and educators from kindergarten through community college.

A wide area network (WAN) connection provides for school access to the ESD's Student and Financial Systems as well as to the Internet. The Internet provides a foundation for schools to communicate with each other and to access educational resources around the world.

ClackNet goals include converting most school sites from SDLC/TwinAx connections to local and wide area network connections via state-of-the-art, cost-effective means such as frame-relay data lines, point-to-point data lines, and, in certain cases, cable providers. (Some schools may retain SDLC connections for MICR check printers and as "hot-site" candidates for disaster recovery).

Updated: 11/4/94



Clackamas County K12 employee with modem
NorthWestNet INTERNET access provider
56K
9600 baud
12 Intel 14.4 fax/modems for dial-up access to the Internet
NCSD K12 northern hub temporary pop site
T1
Northern Hub frame relay
198.236.254.64
255.255.255.224
dns.clackesd.k12.or.us
198.236.20.8
DEC Alpha 3000
DNS, Email
DNS
T1
72XHCGS17197
S3
E0
to WESD via the Columbia Cable INET
198.236.1.0
IP
3COM
RF Modem
3COM NB8 Router
E
198.236.12.98
255.255.255.224
E1
198.236.12.97
255.255.255.224
198.236.254.68
255.255.255.224
IP 198.236.20.4
IPX 802.3
198.236.13.1
Cisco AGS+ Router
Clackamas ESD
IP
SRB
SNA
198.236.12.33
255.255.255.224
ipx 08660400
198.236.12.65
255.255.255.224
ipx 06200001
198.236.19.129
255.255.255.192
ipx 99900004
198.236.14.1
S0
S1
S2
T0
T1
HP 10BaseT 12-port Hub
198.236.20.3
IPX 99900001
AT 1-10
802.3
ClackSAA1
NetWare SAA 1.3B
99900051
Novell-to-AS/400 "gateway" to the Student and Financial Systems on the IBM AS/400's
SNA
SNA
IP 198.236.13.0
IPX 99900002
AT 11-20
16Mb Token Ring 1
16Mb Token Ring 2
IP 198.236.14.0
IPX 99900003
AT 21-30
SNA
slot 3
slot 4
ClackESD
NetWare 3.11
99900050
IBM AS/400 midrange computers
SNA
IP
SISNET
Office Vision/400 with SMTP Email Gateway.
IBM TCP/IP - 80 concurrent TCP/IP sessions.
sisnet.clackesd.k12.or.us
401019144071
198.236.13.2
IP
SNA
FISNET
fisnet.clackesd.k12.or.us
4010A8818021
198.236.13.3
SNA
DPSNET
DPSNET
4010A1928021
SNA
MRSNET
MRSNET
401025676021
traditional method of connecting
Dedicated SDLC lines connecting over 50 Clackamas County school sites to the ESD's AS/400s.
56K
5USDA014844
56K
5USDA017206
56K
72XHGL16985
198.236.12.34
255.255.255.224
Cisco 2501
Canby High School
198.236.11.1
ipx 08660401
Ackerman
198.236.12.66
255.255.255.224
Cisco 2501
Oregon City Dist
198.236.57.1
ipx 06200001
ipx 99900004
Clacknet Frame Relay
ip
198.236.19.128
255.255.255.192
56K
56K
56K
56K
198.236.19.130
255.255.255.192
Cisco 2501
Boring UG
Boring Prim.
198.236.58.1
198.236.19.131
255.255.255.192
Cisco 2501
Sandy Grade
Cedar Ridge
198.236.60.1
198.236.19.132
255.255.255.192
Cisco 2501
Firwood
198.236.61.1
198.236.19.133
255.255.255.192
Cisco 2501
Bull Run
198.236.62.1
198.236.19.134
255.255.255.192
Cisco 2501
Kelso
198.236.63.1
198.236.19.136
255.255.255.192
Cisco 2501
Knight
198.236.59.1
ipx 08614001
198.236.19.137
255.255.255.192
Cisco 2501
Eccles
198.236.17.1
ipx 08620701
198.236.19.138
255.255.255.192
Cisco 2501
Trost
198.236.18.1
ipx 08624701
198.236.19.135
255.255.255.192
Cisco 2502
West Linn HS
198.237.192.33
198.237.193.0
198.236.19.139
255.255.255.192
Cisco 2501
Oregon City HS
198.236.15.1
198.236.16.0
198.236.19.140
255.255.255.192
Cisco 2501
Colton Middle
198.236.X.X

CHART 5

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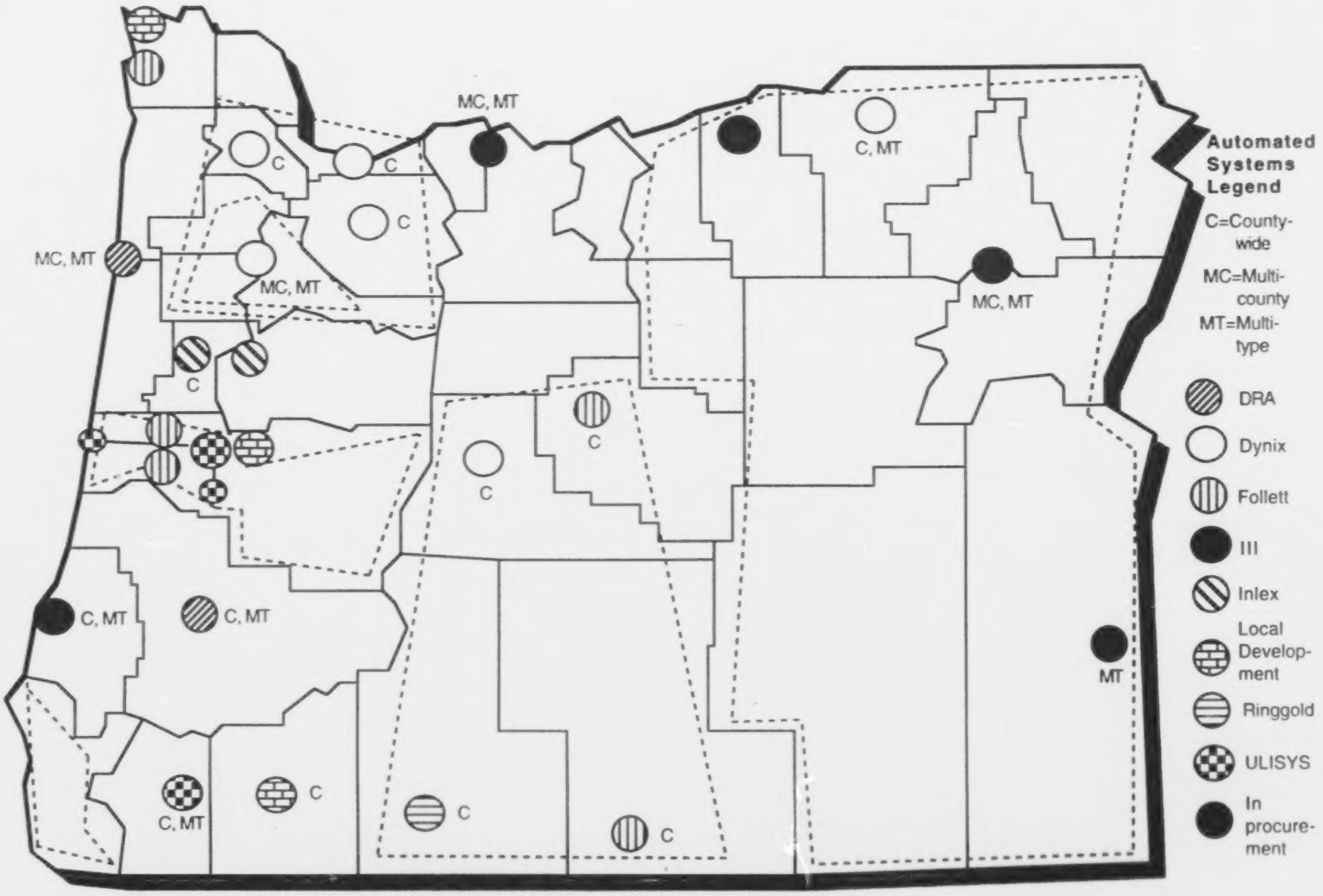
CHART 6

Automated Public Libraries and Resource Sharing Systems


MC, MT
C
C
C
C, MT
MC, MT
MC, MT
MC, MT
C
C
C
C
C, MT
C, MT
MT
C, MT
C
C
C
Automated Systems Legend
C=County-wide
MC=Multi-county
MT=Multi-type
DRA
Dynix
Follett
III
Inlex
Local Development
Ringgold
ULISYS
In procurement

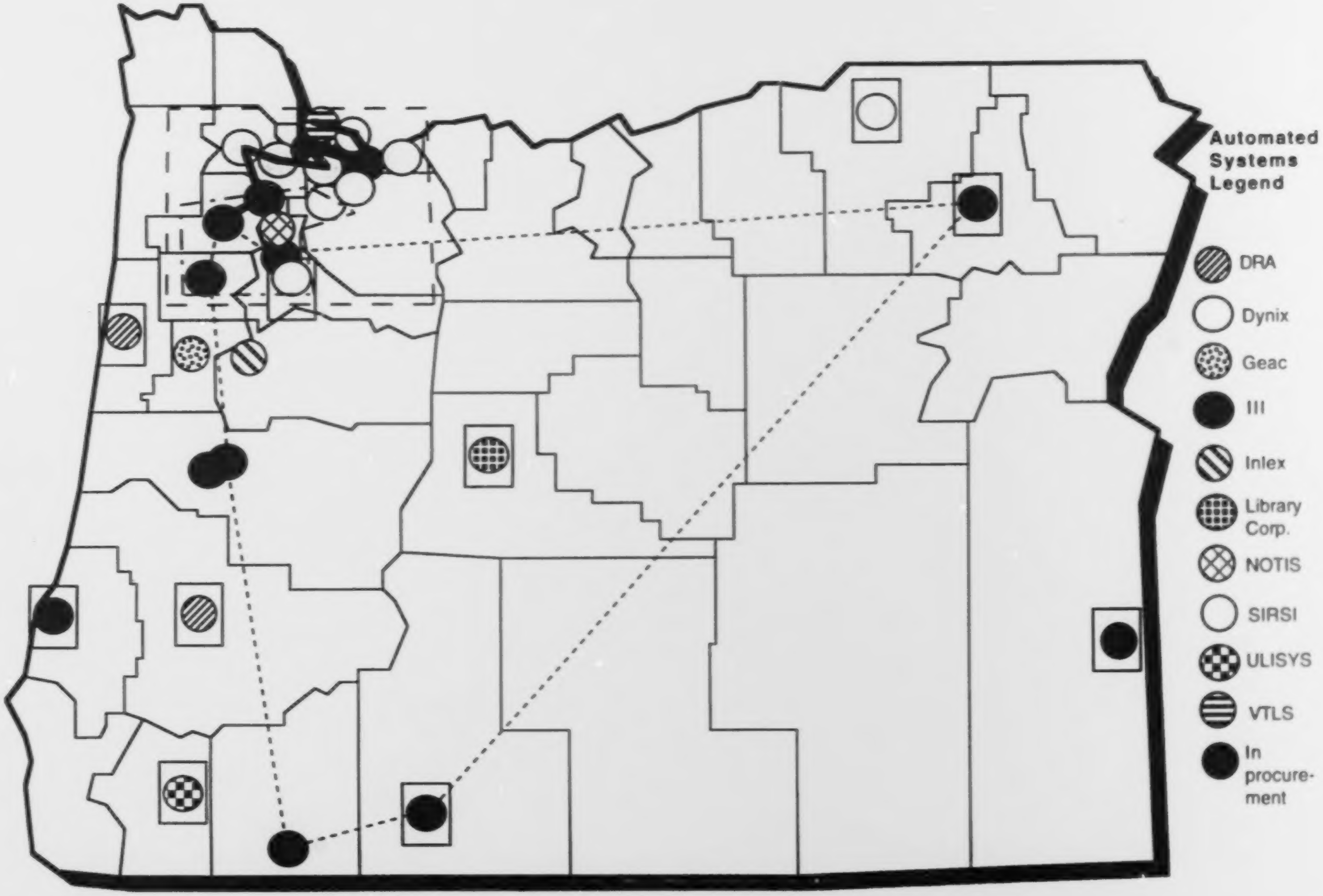
Resource Sharing Systems Legend ┆ Indicates participation in a multi-library automated public access catalog (Lane County), linked systems network (North Valley Library Link, Valley Link), CD-ROM public access catalog (Curry Libraries Area Network, South Central Oregon Public Access Catalog, Eastern Oregon Library Network), or regional bulletin board (Eastern Oregon Information Network).

OLA Resource Sharing Committee, 1994 OLA Annual Conference, Sunriver, Oregon

4-7-94

CHART 7

Automated Academic Libraries and Resource Sharing Systems


Automated Systems Legend
DRA
Dynix
Geac
III
Inlex
Library Corp.
NOTIS
SIRSI
ULISYS
VTLS
In procurement

Resource Sharing Systems Legend

☐ Indicates participation in a multi-type library automated system (e.g. Coastline-Coos County, Pioneer Network-Union and Baker Counties), or CD-ROM PAC (e.g. South Central Oregon Public Access Catalog).

- - - - - ORBIS

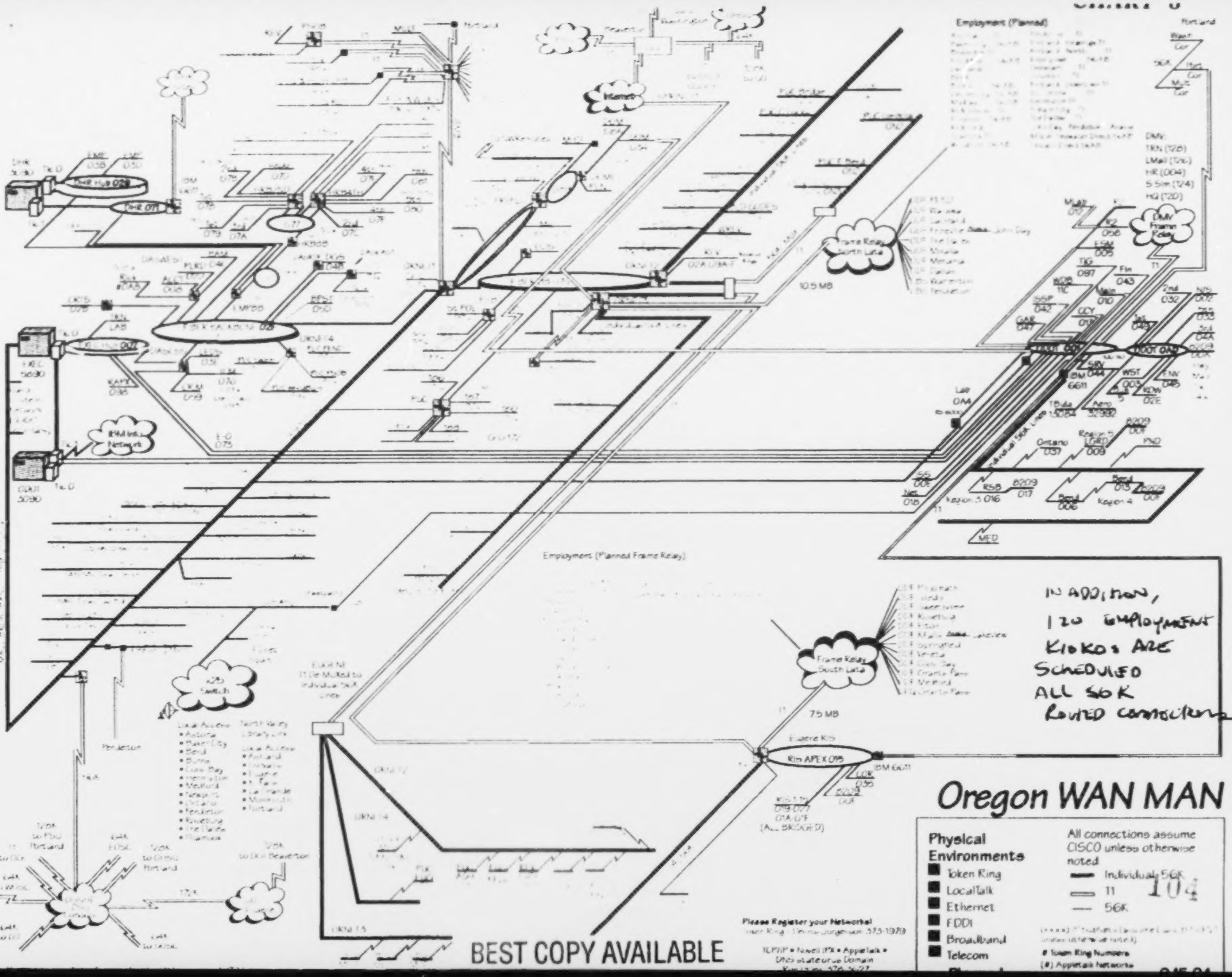
— · — Valley Link

━━━ PORTALS

— — North Valley Library Link

OLA Resource Sharing Committee, 1994 OLA Annual Conference, Sunriver, Oregon

4-7-94



Employment (Planned)
Portland
DMV
TRN (128)
LMall (126)
HR (004)
S Slm (124)
HQ (120)
DMV Frame Relay
Frame Relay North Lata
10.5 MB
Internet
Beaverton
DHR Hub 028
DHR 071
FIBER WALKER 023
EXEC 5090
IBM Info Network
EDDI 3090
Tie D
E-O 073
Individual 56K Lines
Ontario 037
Region 5
LGRD 009
PND
RSB Region 3 016
B209 017
Bend 006
Region 4
MED
IBM 6611
Aero 32982
Employment (Planned Frame Relay)
Frame Relay South Lata
X25 Switch
Pendleton
Local Access
Astoria
Baker City
Bend
Burns
Coos Bay
Hermiston
Medford
Newport
Ontario
Pendleton
Roseburg
The Dalles
Klamath
North Valley Library Link
Local Access
Portland
Corvallis
Eugene
K. Falls
La Grande
Monmouth
Portland
7.5 MB
Eugene KIS
KIS APEX 015
IBM 6611
LCR 035
B209 00F
KIS 1 to 019 027 01A-01F (ALL BRIDGED)
DKNET2
DKNET4
DKNET3
128K to PSU Portland
64K EOSC
128K to OHSU Portland
128K to OGI Beaverton
128K
64K to WOSC
64K to OIT
64K to UO
64K to SOSC
Oregon WAN MAN
Physical Environments
▪ Token Ring
▪ LocalTalk
▪ Ethernet
▪ FDDI
▪ Broadband
▪ Telecom
All connections assume CISCO unless otherwise noted
Individual 56K
T1
56K
# Token Ring Numbers
(#) Appletalk Networks
Please Register your Networks!
TCP/IP • Novell IPX • Appletalk •
DNS state.or.us Domain

IN ADDITION, 120 EMPLOYMENT KIOSKS ARE SCHEDULED ALL 56K ROUTED CONNECTIONS

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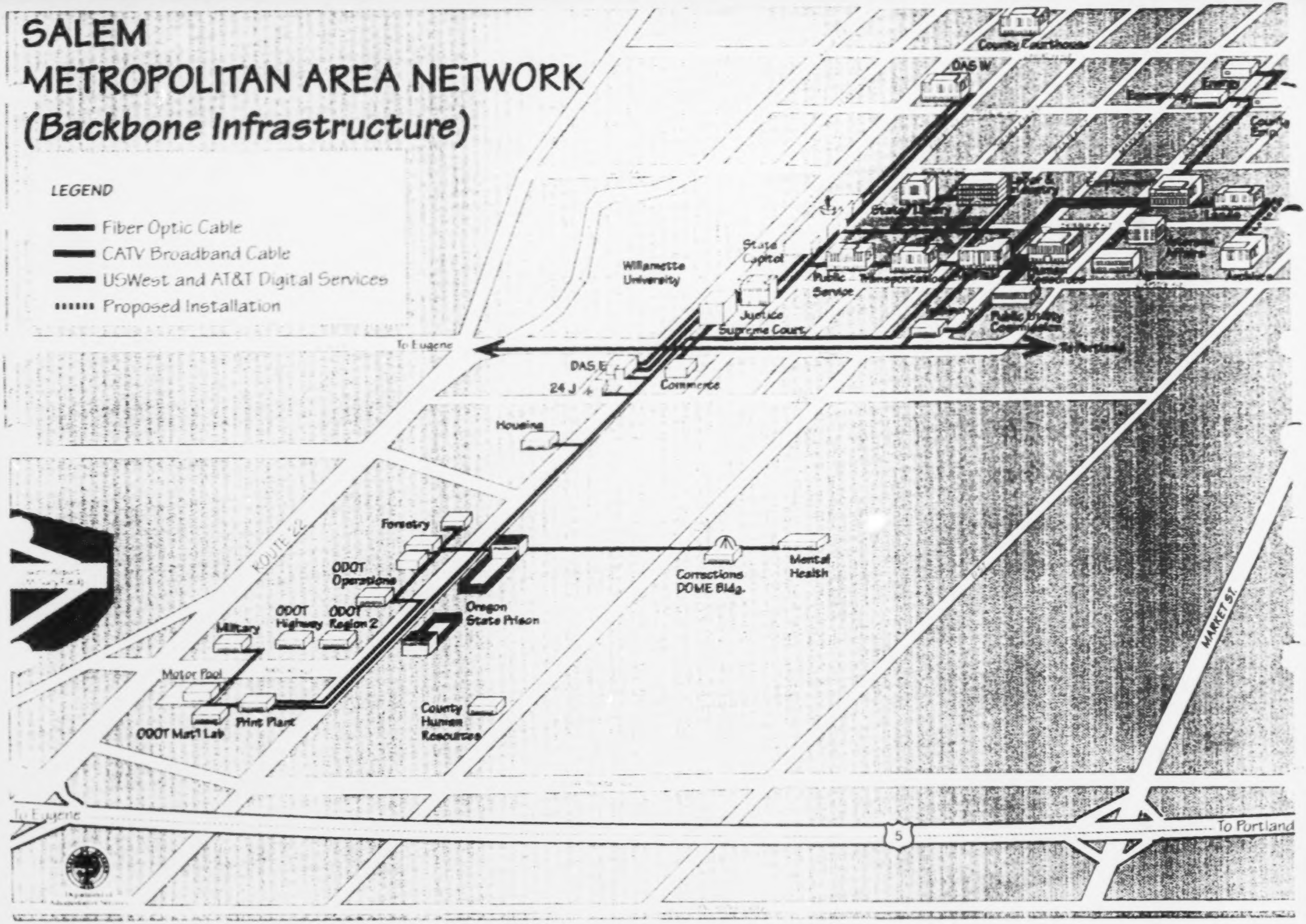
CHART 9

SALEM
METROPOLITAN AREA NETWORK
(Backbone Infrastructure)

LEGEND

- Fiber Optic Cable
- CATV Broadband Cable
- USWest and AT&T Digital Services
- Proposed Installation


County Courthouse
DAS W
Energy
Emergency
Courts Emp
Labor & Industry
State Library
Lands
Veterans Affairs
State Capitol
Public Service
Transportation
Human Resources
Archives
Willamette University
Justice
Supreme Court
Public Utility Commission
To Eugene
To Portland
DAS E
24 J
Commerce
Housing
Forestry
ODOT Operations
ODOT Highway
ODOT Region 2
Military
Motor Pool
ODOT Mat'l Lab
Print Plant
Oregon State Prison
Corrections DOME Bldg.
Mental Health
County Human Resources
ROUTE 22
MARKET ST.
To Eugene
5
To Portland

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APPENDIX
TWO

OREGON NETWORKS AND NETWORKING
BACKGROUND PAPER

Prepared by: John Sechrest, Oregon State University, for the Oregon Telecommunications Forum, October 1994

Computer Networks

Widespread growth of computers and a growing understanding of their capabilities has resulted in a demand to connect computers together. This computer "networking" often begins at a small, local level for the purpose of sharing printers, and can escalate into a global activity. The Local Area Networks (LAN) that are created to share local resources provide the launch point for establishing Wide Area Networks (WAN). If these networks all speak the same language (TCP/IP) then they can work together to exchange information. The Internet is the collection of all networks that speak TCP/IP to each other.

The Internet

The Internet is growing at over 10% a month. This extreme growth rate is changing the face of computer networking and may change the face of how people go about doing their daily business. There are currently an estimated 25 million people on the Internet. All of these people can communicate with each other using Internet tools.

The Internet provides the tools for exchanging information around the world. These tools come in many shapes and sizes. The most often used tool is electronic mail (e-mail). This provides for person to person communications on the network. There are forums shared around the world for discussing different topics. These forums provide an opportunity for geographically separated people to work together on similar interests. These person-to-person communications are just the beginning of the network opportunities.

The Internet provides direct access to computers and files around the world. The distance from Oregon to Munich, Germany is about a quarter of a second on the Internet. This makes it possible to use a computer in Germany for real work. Some of this work might be using databases of specialized information, taking a picture on a remote telescope or accessing a library. With additional tools that work directly between machines, it is possible for people to interactively "talk" with each other on the network.

Not only is it possible to search the network for information, it is also possible to develop "information areas" that are published to the whole network. These areas are locally created repositories for text, graphics, and sound files which can be easily accessed by using standard network features. Through the use of such tools and programs as Gopher, Mosaic, and the World Wide Web, any network member can become a publisher. These tools provide a seamless, easy way to access information, sounds, and pictures distributed across many machines on the network.

These network tools move information across Internet using wires and lines that serve the "data pipes" of the network. These pipes can be of different sizes and speeds. By speaking TCP/IP language all these networks can talk to each other. However, some may talk slowly, others more rapidly. But, as you might expect, the faster a data services is the more it costs.

The Technology

Just as costs increase with increased connection speeds, the locations where different services are available become more restricted. The further away from large population centers you go, the fewer services are available. This creates places in the state that have a difficult time getting access to the network. For Oregon, it is possible to get high speed data access in the densely populated areas of the Willamette Valley. Outside those areas, there are very few organizations that have dedicated connections that are faster than 56Kbps.

As you increase the speed of a connection, you increase the capabilities of the services that can be provided on the line and you increase the cost. The chart which follows shows the relationship between the services that are available and the line speeds that are needed to provide good service. It also show a relative price, to give a relative relationship between the different methods.

	E-mail Gateway	Dial Up Terminal Emulation	Dial Up Slip	Dedicated Slip	56K Dedicated	T1 Dedicated	T3 Dedicated	OC3 Dedicated
Relative Cost/mo	$10	$10	$30	$100	$500	$1300	$10000	$20000
Bandwidth	Batch	14.4k	14.4k	14.4k	56k	1.5M	45M	155M
Email	yes	yes	yes	yes	yes	yes	yes	yes
Almanac/ Majordomo	yes	yes	yes	yes	yes	yes	yes	yes
Multi Media Mail	almost	almost	yes	yes	yes	yes	yes	yes
Telnet	No	yes (but)	yes	yes	yes	yes	yes	yes
FTP	No	yes (but)	yes	yes	yes	yes	yes	yes
Gopher	No	yes (but)	yes	yes	yes	yes	yes	yes
Wais	No	yes (but)	yes	yes	yes	yes	yes	yes
WWW	No	yes (but)	yes	yes	yes	yes	yes	yes
Pictures (small)	No	No	yes	yes	yes	yes	yes	yes
Batch Sound	No	No	yes (but)	yes	yes	yes	yes	yes
Pictures (Big)	No	No	No	almost	almost	yes	yes	yes
Movies	No	No	No	almost	almost	yes	yes	yes
Live Audio	No	No	No	No	almost	yes	yes	yes
Live Video	No	No	No	No	No	almost	yes	yes

BEST COPY AVAILABLE

The bandwidth of a data pipe is the speed that it can carry data. Dial-up and gateway services access normal (slower) commercial phone lines with limited bandwidth. Dedicated lines are leased cables (often fiber optic) independent of normal carrier traffic configured to high speed digital transmission. Data connections have the following ranges:

- BBS--No connection
- Public BBS
- Dialup Mail Gateway
- Dailup (.3k, 1.2k, 2.4k, 9.6k, 14.4k, 28.8k)
- Dedicated line (56k, T1-1.5M, T3-45M)

By studying the chart on the preceeding page, we are able to see that different speed provide for different levels activities and uses. If we couple this observation with the information that there are very few network connections outside the densely populated areas of the Willamette Valley that have greater than 56k capabilities, then we see that there are many activities over a telecommunications-linked computer network that are not possible for most rural Oregonians.

Applications

With basic e-mail access it is possible to do a great deal. Chemeketa Community College is able to run courses like Writing 127 over an e-mail only type connection. However, this type of connection limits the work that is possible. If that same class were able to use Mosaic, a World Wide Web reader, then the class would have access to sounds, pictures, interactive forms and replies. This is a significant difference in ability.

At the other end of the spectrum, the NERO network is experimenting with group class work, collaboration and instruction over the network. This interactive collaboration makes it possible for geographically distant groups to share resources and work using interactive audio and video. While these groups are having interactive discussions, they are also sharing files and data using Mosaic and the World Wide Web.

Mosiac is the fastest growing application using the Internet. Many commercial organizations are beginning to look at it as a way to do business. Commerce Net has started research and development of using Mosaic for electronic commerce. It is now possible to order books, flowers, computer equipment and pizza by using Mosaic.

As business learns how to do commerce effectively and efficiently with networking tools, those businesses that are connected to the Internet have the opportunity to develop market share in these new emerging electronic markets. To truly take advantage of this opportunity, Oregonians will need the associated skills for using network services. Unfortunately, at the current time, many areas in the state do not have even minimal access to networks, and so are unable to develop the skills needed to participate in these new markets.

Examples of Oregon's Emerging Networks

Oregon has many active groups working on networking of some type. The list which follows is a necessarily incomplete list of groups working on networking around the state. There are many local

and community groups planning, developing, testing and operating networks. .pa
OPN/EFN are the only "Freenet" in the state. This system is free to it's users and gets its funds from donations. It provides full access to the Internet with complete access to the network. EFN has a high volunteer component.

Lane Online/Eugene FreeNet / Oregon Public Networking Clif Cox
clif@efn.org
(503) 484-9637

The Oregon State University Computer Science Outreach Services (CSOS) provides dial-in services to the public for a fee on it's PEAK service. It has full Internet access, local information services and SLIP access. CSOS provides training and classes. It has a high volunteer component.

Community Outreach--John Sechrest
sechrest@cs.orst.edu
(503) 737-5562

The Oregon State University Extension service has e-mail via e-mail gateways to every county in the state. Every county extension office can get e-mail. OES is moving from e-mail gateways to direct IP connections.

OSU Extension--Owen Osborne
osborneo@oes.orst.edu
(503) 737-2713

Through University of Oregon CIS department, there is a program to investigate the tools to support commerce on the Internet. This develops the ideas like the Commerce net activities in Oregon.

Electronic Commerce--Steve Fickas
fickas@cs.uoregon.edu
(503) 346-3964

Eastern Oregon State College delivers a number of computer-based instruction programs via ED-NET's Compass network. High school students in a number of rural communities are taking office practice courses from college faculty by computer conferencing.

Computing and Telecommunications Service Center--Marvin Taylor
mtaylor@eosc.osshe.edu
(503) 962-3606

The Software Association of Oregon sponsors a dial-in BBS that provides small software companies with a forum for discussion and e-mail.

Oregon Telcom--SAO Pete Mackey
seaquest@netcom.com
(503) 531-0252

Chemeketa Community College provides instruction through an e-mail program.

Community Colleges--Bob Hunter
bob.hunter@chemek.cc.or.us
(503) 399 7997

Oregon ED-NET's Compass provides Dial-in service to a Freenet system with terminal access. This system has the widest rural access available today, but does not provide full internet access.

Compass/Ednet--Nancy Jesuale
nancy@ednet1.osl.or.gov
(503) 293-1996

The K12-Net newsgroups provide important content for the process of doing K-12 education using the network. This provides a place to go for K-12 information.

K12net--Janet Murray
janet@psg.com
(503) 280-5280 x450

The Department of Education has a contract with NWNet that helps schools get onto the network.

K12 - Oregon Public Education Network Tom Cook
tom.cook@state.or.us
(503) 378-3310

The Network for Education and Research in Oregon provides the only Very High speed data network in the state. This experimental network shows many of the issues that will be faced when deploying networking for leading edge technologies.

Nero--Tad Reynales
tad@engr.orst.edu
(503) 737-5235

There are many commercial services between Eugene and Salem. They offer services from dial up Slip to full High Speed Data services. Commercial services include:

Alternet
alternet-info@alter.net
(800) 488-6383 PSI

PSI
info@psi.com
(800) 827-7482

Netcom
info@net.com
(800) 353-6600

Sprint
bdoyle@icm1.icp.net
(503) 904-2167

Rainnet
sales@rain.com
(503) 227-5665

Teleport
jamesd@teleport.com
(503) 223-4245

NWnet
nic@nwnet.net
(206) 562-3000

The author volunteered to prepare the paper for the Oregon Telecommunications Forum. The views and representations in the paper are the author's and not necessarily those of the Oregon Telecommunications Forum membership.

STATE OF OREGON'S ROLE RELATED TO TELECOMMUNICATIONS: aka SUPERHIGHWAY

BACKGROUND PAPER

Prepared by: Curt Pederson, Chief Information Officer, State of Oregon, for the Oregon Telecommunications Forum, October 1994

> *"We are determined to move from an industrial age government, from a government preoccupied with sustaining itself to a government clearly focused on serving the people."*
>
> Vice President Al Gore
> May 24, 1993

The hype and activity around the "Information Superhighway" has been termed the "Gold Rush of 1994." Oregon state government is in the middle of the rush as we attempt to update the state government's strategic plan and participate in updating comprehensive statewide planning efforts that includes both the private and public sector. Suggested roles for the state's involvement in the "Superhighway" have included: builder, driver, passenger, hitchhiker, cheerleader, catalyst and road kill. Oregon state government has already invested millions in developing near state-of-the-art networks to serve voice, video, and data needs of government. Telecommunications vendors are looking for business rewards at the same time government is searching for the social benefits of further connecting government to the "Information Superhighway." Now, rather than invest millions more to complete the superhighway, we have a chance through planning and cooperative efforts to leverage the capabilities of all interested parties. The people are demanding that government regulators provide them with "universal access" to more than just dial tone services at the same time as many in the private sector are asking government to back away and let the solution be market driven. The concepts of "electronic commerce" and "electronic democracy" seem more possible than ever if only the various interests can work together on a common overall strategy on how we get from here to "universal access."

Existing Government Infrastructure

In many rural areas the existing government network infrastructure exceeds that available to the local private sector and citizens at large. This infrastructure has been installed and is maintained, in most cases, by private vendors after being selected through a competitive process. The successful and growing networks of the state government are of great interest to others beyond the walls of government. A question frequently asked is "Why doesn't the state share the planning and capacity to serve the broader interests of the community?" The state's Wide Area Backbone Network is available to municipal government statewide but due to the fixed monthly telecommunications cost (regardless of usage) and statutory restrictions it is not affordable mostly to smaller municipal agencies or legally available to the community at large. Policies that would encourage small towns of Oregon to connect and take advantage of the state's existing investment in voice, video, and data infrastructure need to be debated.

Another common suggestion, that the state leverage its buying power as the largest single telecommunications consumer, has the potential of shaping the vendors' adoption and provision of new, advanced telecommunications services throughout the state. State government's buying power can increase the amount of investment and speed the deployment of new technology toll areas of Oregon.

As an example, the state is now considering competitively contracting for a statewide "frame relay" service. The benefits of increasing service to state agencies and stabilizing costs also would have the side benefit of providing "frame relay" service in the more remote locations that would not have been able to provide the revenue to stimulate the vendor investments needed to support the new service. Beyond "frame relay" the same argument can be made for emerging technologies such as ATM, Sonnet and ISDN.

The public good can be enhanced by bringing new, advanced telecommunications capabilities faster to more areas of the state by driving the vendors' business decisions with state government's expenditures. EDNET's success in rural Oregon and the resulting benefits in education, commerce, and health care are just now being recognized. Despite suggestions that the "free market" should be allowed to determine what services are provided when, it is not readily believed by many telecommunications experts or rural citizens that the "free market" will soon bring the most needed services, such as "frame relay," to the town at the end of the road.

Much of the discussion today is centered around the Internet as our "superhighway." If this is the case then the "superhighway" appears to have many "potholes" needing repair before we can assure a safe and timely ride. As the traffic and number of frivolous items are increasing every day, it would appear that a wider band, better managed electronic highway system will be needed in the near future.

Many well meaning, talented Internet pioneers are creating the equivalent of an Electronic Oregon Trail. While they are providing us with the direction and excitement of the new electronic frontier, it appears that they may also be overestimating the short-term benefits of connectivity and underestimating the long-term benefits. To fully capture the benefits of the proposed "superhighway" it would appear that a selective prepaid dedicated telecommunications infrastructure needs to be built. Unfortunately, many that see the benefits appear unwilling to assume the risks or pay the costs or forge the collaborative relationships necessary to achieve these goals in times of severe resource constraints.

In summary, the current interest in the "Superhighway" provides us with the energy and interest needed to "re-think" government's role and traditional service delivery mediums. A very open and public debate needs to take place regarding the state's role in telecommunications and development of the "superhighway":

- should the state more actively promote private sector investment in telecommunications infrastructure;

- should it extend through regulation the "universal service" concept to ensure that information resources are available to all at a price they can afford;

- should it act as a catalyst in promoting technological innovation within government;

- does it have a responsibility to provide open electronic access to government information; and

- will it be allowed to develop the appropriate private/public partnerships that could better leverage the resources and the needs of all communities of interest.

The current interest in the "Superhighway" provides us with the energy and interest to "re-think" government's role and how we serve the people.

The author volunteered to prepare the paper for the Oregon Telecommunications Forum. The views and representations in the paper are the author's and not necessarily those of the Oregon Telecommunications Forum membership.

TELECOMMUNICATIONS--TELEPHONE SERVICES
BACKGROUND PAPER

Prepared by: Gary Bauer, Executive Director, Oregon Independent Telephone Association for the Oregon Telecommunications Forum, October 1994

During the Industrial Age in the late 1800s and early 1900s, the telephone business consisted of copper wires strung on poles or along the tops of fence posts. Operators were necessary in order to route and connect calls from one location to another and people shared their telephone line with their neighbors over multi-party lines.

With the development of new technology, the Industrial Age has been transformed into the Information Age. The technology has moved from analog (voice) to digital which translates voice into numbers. Today's calls are transmitted over copper, fiber optics, microwave, wireless, satellite, and coaxial cable systems. With these technologies in place, along with the convergence of computers and telecommunications, the telephone network has been transformed into an information superhighway.

Oregon is currently served by 34 local telephone companies and cooperatives known as local exchange carriers. All of these companies provide essential communication services to their communities and rural customers. In addition to local telephone service, these companies provide a connection between the customer and their long distance telephone carrier(s).

The Oregon telephone industry's vision of the future communications environment is one in which all consumers will enjoy new levels of choice and control over a wide range of services, delivered at reasonable prices over the public switched network, providing seamless interconnectivity with private networks.

The industry believes a modular, market driven approach to developing the communications network infrastructure will provide Oregonians access to a competitive array of communications and information products and services, offered at a reasonable price. Wide deployment of this infrastructure will enhance the economic development of Oregon, creating new jobs and opportunities throughout the state.

The telecommunications companies providing Oregonians with local telephone service believe it is important to:

- Build the infrastructure to meet customers' growing communications needs.
- Ensure that communications products contribute to customer competitiveness in the global marketplace, positioning communications services as a tool for economic development, educational excellence, improved health care and the widest possible range of services to the home.
- Identify opportunities where communications services can assist state and local governments as well as educational institutions in addressing their need to provide greater services with less resources.

- Deliver products and services in a cost-effective, competitive manner.

Education is an important element in assuring Oregon's future economic vitality. Many of the telephone companies have been working with schools in their service areas to see that new and existing classrooms are wired for voice, data and video capabilities. This is an important first step to assuring that students in Oregon will have an opportunity to utilize the full range of educational services that are becoming available to schools today.

Technology is rapidly changing making it difficult to predict the future of the telecommunications industry. Research entities continue to push the extent of communication over copper wires. The October 1, 1994 issue of "America's NETWORK" listed some recent technology advancements:

> "Technologists know short spans of twisted-pair copper can handle very high bitrate digital signals. Thus existing telephone loops can connect fiber-to-the-curb pedestals to residential subscribers, opening the door for telephone companies to provide ubiquitous video-on-demand services."
>
> "Just months after Hayes trumpeted its 28.8 kbps modem, AT&T Paradyne announced it would bring to market a modem capable of transmitting data at 33.6 kbps over standard phone lines."

A call can consist of:

voice--something you hear; and/or

data--works or numbers, charts or graphs that carried over telephone lines and reproduced so you can see them; and/or

video--moving pictures that get carried over telephone lines.

Today, grandparents can call their grandchildren, carry on a conversation, see them as they are talking and have them draw a picture on the screen. In a business application, two individuals can work on a sales presentation at the same time and print it out at both locations.

Telephone companies have been installing fiber optic cables for a number of years. Fiber optics are important because large amounts of data and calls can be transmitted at a single time. Today's highest capacity lightwave systems carry as many as 80,000 simultaneous telephone calls per fiber pair. However, AT&T Bell laboratories has built an experimental "16 lane information superhighway" that can handle 2.5 million calls simultaneously or any mix of voice, data, and video.

Telephone companies are using fiber to connect their central offices (the large computer switches that route calls and provide many of the services to customers). In addition, they are using fiber in the "local loop" from their central office to businesses and residential customers. There are various network designs that involve using fiber to the pedestal or a common drop point and then using either fiber, copper wire, or coaxial cable to take the signal on to the customer's premises. One virtue of copper loops is that the phone can be powered remotely, as in today's network. This becomes important when a customer loses power and still needs to use their telephone.

The regulatory environment for telephone companies is complex. Telephone companies are regulated at the federal, state, and local levels. All telephone carriers are regulated by the Federal Communications Commission (FCC) which also has jurisdiction over interstate communications. The FCC is involved in such issues as financial and accounting matters, competitive issues, support mechanisms for assuring affordable service in high cost areas of the nation, and issuing licenses for wireless communications. The Oregon Public Utility Commission regulates intrastate telephone rates, consumer policies, local toll free calling areas, competition for local service, and local support programs for assuring that local service is affordable. Joint Boards are created for the FCC and states to work out how to allocate joint costs between the two jurisdictions. Cities provide utilities a franchise that allows them to use city right of ways in exchange for agreements to operate within certain parameters and they require the telephone companies to pay a franchise fee of seven percent of their revenues derived from local basic service.

In 1984, US West Communications, along with six other regional Bell operating companies, was created as a result of the court ordering AT&T to divest itself of local telephone operations. Since that time, hundreds of long distance providers have been started and they market various long distance calling programs.

While AT&T is currently prohibited from providing traditional local telephone service, many of the new long distance companies along with cable companies are forming entities to provide either limited or full local telephone services. The Oregon Legislature opened the way in 1993 for other companies to provide local telephone service in competition to existing companies. Today, three companies have received approval to provide dedicated transmission services in the Portland metropolitan area in competition with US West and GTE. Other companies have indicated an interest in providing limited or full local telephone service.

Wireless technology is also changing. For a number of years, a customer could purchase a radio telephone that would allow them to place calls over a signal that was shared by a number of other users and was similar to the multi-party lines in the earlier days of telephone. The cellular telephone was developed and it allows a caller to still utilize the airwaves but affords the caller more privacy and portability. Just as wire line telephone has gone from analog technology to digital, so is the cellular network. Today, wireless systems consist of radio telephones, cellular phones, personal communications systems, and satellite communications. Video signals, data, and voice communications are capable over cellular systems. While AT&T is prohibited from entering into the traditional (wired) local telephone business, they have purchased McCaw Cellular, the largest cellular company.

The FCC is in the process of auctioning off "spectrum" or space on the air waves for the new personal communications systems that are now being developed. Customers have indicated an interest in mobility and the technology will meet their demands. The FCC is expected to issue up to seven licenses in an area for this new wireless service.

Fiber optic cable and broadband coaxial cable are the distribution vehicles of choice for both the cable television and telephone industries, two communication market suppliers that have entered a period of direct competition. The cable industry would like to enter into the telephone business and the telephone industry would like to enter the cable business. The FCC and the Oregon Public Utility Commission have proceedings underway to "unbundle the local telephone network" and cause telephone companies to open their networks to competitors. This includes allowing a competitor to locate their equipment in a telephone company's central office allowing a competitor to use the network built by the telephone company. This same effort is not underway allowing competitors the ability to connect to a cable company's system. The FCC has rules that ban the provision of cable television service by many local telephone companies and their affiliates. These competitive issues are at the heart of court proceedings and congressional debates as technology converges allowing voice, data, and video to be delivered over many different mediums.

Today the public has expectations for a full range of information age education, entertainment, and two-way interactive services, including high-definition television, videotext, home shopping, video phones, and mobility to carry on business wherever and whenever they so desire. Technology is changing rapidly and new entities are entering the marketplace and providing customers the opportunity to make choices and decide for themselves the services they will receive.

CAPABILITY OF EXISTING "COPPER" NETWORK

	POTS (1)	DIGITAL DATA	T-1
Customer	Residence & Business	Business	Business
Network Capability	▪ Can provide digital connectivity ▪ Full range of telephony services ▪ Can transmit data at up to 32,000 bits per second (2) ▪ Can provide compressed video ▪ Can provide other optional features and services	▪ Can provide digital connectivity ▪ Full range of advanced telephony services ▪ Can transmit data up to 144,000 bits per second (2) ▪ Can provide full-motion video (3) ▪ Can provide other optional features and services	▪ Can provide digital connectivity ▪ Full range of advanced telepony services ▪ Can transmit data at up to 1,544,000 bits per second (2) ▪ Can provide full-motion video (3) ▪ Can provide other optional features and services
Applications	▪ Work at home ▪ Distance learning ▪ Tele-medicine - Ultrasound 20 minutes - CT 1 hour - MRI 4.2 hours	▪ High speed data ▪ Distance learning ▪ Tele-medicine - Ultrasound 2.5 minutes - CT 7.8 minutes - MRI 31 minutes ▪ ISDN (Primary) 144,000 bits per second	▪ High speed data ▪ Distance learning ▪ Telemedicine - Ultrasound 0.2 seconds - CT 19.5 seconds - MRI 1.3 minutes ▪ ISDN (Primary) 1,544,000 bits per second
Notes:	(1) "POTS" is plain old telephone service. (2) Modems typically transmit at 9,600 - 14,000 bits per second. (3) Industry standards define full-motion video as 30 frames per second		

The author volunteered to prepare this paper for the Oregon Telecommunications Forum. The views and representations in the paper are the author's and not necessarily those of the Oregon Telecommunications Forum membership.

UNIVERSAL TELECOMMUNICATIONS ACCESS
BACKGROUND PAPER

Prepared by: Terry Edvalson, Regional Services Institute Director, Eastern Oregon State College and Sandy Ryman, Director, Northeast Oregon Health Education Center for the Oregon Telecommunications Forum

> *"Universal access is the concept that all citizens and consumers should be able to use telecommunications and information services through some means, either public or private. Access is often determined based on the consumer's financial capability and ownership of appliances (cellular telephones, cable TV hookups, personal computers, etc.) that will connect to the infrastructure...."*[1]

The underlying, guiding principle of universal telecommunications service established in 1934 by the Federal Communications Commission is that every home and business in the country should have access to a telephone at the lowest reasonable cost. Telephone service to costly, hard-to-serve populations (e.g., small, widely dispersed rural populations and low-income urban neighborhoods) is subsidized by other users to keep rates at an affordable level, allowing universal access.

The Oregon legislature in 1991 (SB 1208) established a goal that **all** (emphasis added) Oregonians should have affordable access to an **integrated** private and public telecommunications infrastructure that provides voice, data and image information services.

The policies proposed in 1992 in *Oregon Connects* extends the concept of universal telecommunication service to include ensuring all Oregonians have access to high quality, broadband telecommunications technologies that support "...voice, data, and image information services for meeting their economic development and quality of life aspirations." The ultimate application of this policy would connect all of Oregon's homes, schools, hospitals and work places to high speed telecommunications technologies capable of providing integrated multi-media voice, data, and video connections to the rest of the world.

The *Oregon Benchmark Report to the 1993 Legislature* proposes telecommunications standards for measuring some components of universal access (percentage of Oregon households with single-party and touchtone-capable telephone service, medium-speed data capable telephone lines, and personal computers equipped to send and receive data). While the document does establish a standard for universal access to advanced telecommunications ("Percentage of Oregonians with access to high-speed, multi-channel telecommunications lines"), it does not suggest goals.

Implications of New Technologies

Telephone industry deregulation, the rapid emergence of new and changing technologies with increased capabilities, and increased competition in telecommunications is changing the way people

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1. National Association of State Information Resource Executives. (1994) *Development of the National Information Infrastructure: Issues of State and Local Governments.* Lexington, Kentucky: Author.

view the issue of universal access. The importance of being connected by the best available technology is thought to be critical in order to be competitive in the Information Age and world economy. But the advanced technologies are expensive and new economic and regulatory policy decisions are needed to develop an up-to-date, more relevant definition of universal access.

The policy question is no longer whether to provide access to low-cost telecommunications service to every home, business, school, hospital, and government agency. Rather, the policy questions today are:

- What level of technology should everyone have access to and when?
- Should there be subsidies in a deregulated, competitive environment? If yes, who should receive subsidies and who should pay?
- Can new partnerships among customers and providers be developed in a deregulated environment to pay for universal access to broadband telecommunications technologies?

Applications of the New Technologies

Many advanced telecommunications services exist in urban Oregon. While large businesses, government agencies, and higher education institutions are developing and utilizing advanced telecommunications services, the general public, K-12 students, and small businesses have not had the same access or exposure to new technologies. This is particularly true in rural areas. Policy and organizational changes in our institutions' missions may need to take place to ensure that citizens have the opportunity to know how to use advanced telecommunications, a critical component of meaningful universal access in the Information Age.

An Oregon plan for universal access should include an educational component as a means to develop the tools and motivation to use the technology. Beyond answering the questions of what technologies people should have access to and when, if there should be subsidies, and new relationship possibilities, other questions need be addressed. These include:

- How to provide training, motivation, and resources to teachers to learn to use the new, advanced technologies and incorporate them in the educational process?
- How to provide affordable "experimental time" to students, the general public, and small business owners and managers to learn to use new, advanced telecommunications technologies?
- What is the best way to educate the general public to use new telecommunications technologies to enhance their lives right now and in the future?

In summary, the concept of universal telecommunications access is changing in today's rapidly emerging, highly competitive telecommunications marketplace. These changes are, in part, driven by growing customer awareness and demand for access to advanced technologies. New customer-service provider coalitions are beginning to emerge. These coalitions should be required to ensure that the concepts of equality and technological parity are protected for all Oregonians. The regional meetings (December 1994) and the telecommunications conference (January 22-24,

1995) provide an opportunity for Oregonians to discuss the implications and applications of the principle of universal access. The "grassroots" discussion can help public policy makers and telecommunications service providers understand what Oregoninan's believe represents an acceptable level of universal telecommunications access.

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The authors volunteered to prepare this paper for the Oregon Telecommunications Forum. The views and representations in the paper are the authors' and not necessarily those of the Oregon Telecommunications Forum membership.

COST ISSUES OF THE INFORMATION SUPERHIGHWAY
BACKGROUND PAPER

Prepared by: Nancy Jesuale, Operations Officer, Oregon ED-NET, and Jim Williams, Assistant Director, Biomedical Information Center, Oregon Health Sciences University, for the Oregon Telecommunications Forum, October 1994

Building the information superhighway will require a long-term, massive investment. It is projected the information superhighway will be a network of networks, interconnected and joined at various nodes. The networks will be built of a combination fiber optic cables, copper wires, satellites, wireless, and other new technologies yet to be invented.

Networks, just like any infrastructure, require capital to build--funds spent on the wires and cables and equipment to carry the information traffic. Many have attempted to estimate these costs. Highways for cars and trucks cost about $1,000,000 per mile. Just what the information highway will cost is more variable and scaleable. The questions then become, how much traffic must we size for? How large will the information vehicles be? Where will the highway go? Will we build a public freeway versus a toll road? Will all have access or will access be granted on an ability to pay basis?

Universal Access

Universal access is a public policy concept. It means that everyone is entitled to some basic level of services. In health care the universal access concept has meant that everyone should be entitled to some level of health care (or health insurance) regardless of their ability to pay. In telecommunications, universal access has been a policy that all citizens are entitled to basic telephone service at a subsidized rate. In cable television, universal access has meant that every home must at least be passed by the cable, so that if residents want service they can buy it. These policies are variations on a theme that suggests that we cannot allow basic telecommunications services to be provided only to those who can afford to buy them. We must subsidize the development of services to ensure access by all (or most) citizens.

Generally, the fulfillment of a universal access policy means that we have also agreed to make the network infrastructure bigger and more expensive overall--that we have agreed some citizens should be able to use it at rates or fees below the actual cost of providing the service. Simply stated, universal access assures more people have access to services and the basic cost to provide those services will be higher.

We must then deal with the issue of subsidized service. Generally universal access is a policy which can only be implemented in a rate regulated environment. There are three fundamental reasons for this. One, a regulatory authority can establish a rate for service which is below the cost of offering the service. Two, a regulatory authority can regulate the profit level of the service provider to force investment and subsidies. Three, a regulatory authority can limit the number of providers and require that they serve all citizens.

In an unregulated market there is very little incentive to provide universal service unless the cost to provide service is low enough that all who wish to have access can afford to pay. When costs for a service are higher than all can pay a subsidy is sometimes given directly to the consumer of an unregulated service or good. An example is food stamps where the subsidy is given to the consumer, and the price and distribution of food is unregulated.

Questions with which government and industry are struggling with today include:

- Will the information superhighway be regulated?
- Will it be subsidized?
- What will be the basic public policies concerning superhighway access and affordability?

Pricing

Distance/Time sensitive rates: Many strategies exist for pricing various uses, or applications on a network. Most of us are familiar with the pricing of long distance calls. We have basic service for which we pay a flat fee. Long distance calling is generally priced per minute with higher charges during times of peak traffic. Some services, such as dedicated circuits or lines are priced per mile. Many policy makers who know the architecture of the future highways know that distance is not as significant as the size of the vehicle running on the highway. Thus, many are suggesting rate structures that are distance and often time insensitive. In other words, a flat monthly fee.

Bandwidth: Bandwidth is a concept in telecommunications that describes the amount of total network capacity a single communication requires. Video for instance, is wideband--it requires a lot of network capacity to transmit. Voice, or telephone service is narrowband--it requires a small amount of network capacity. In general, wideband applications will cost more to transmit than narrowband applications. Since capacity is directly related to costs, we are well advised to think carefully about scaling the infrastructure to avoid scarcity. Scarcity (or not enough capacity to meet demand) will drive up costs to the user. Conversely, a network that is scaled too large will cost more than necessary and need more revenue to service the indebtedness of the provider--again driving up cost to the user. Finally, we must consider the need to conserve, to share and to use wisely. Certainly we could create a lot of wideband applications and drive up demand for network capacity and the necessity to build infrastructure at great cost. What have we gained? Could we have transmitted the same information without the glossy pictures at half the cost? An example is beginning to be seen in the publishing industry where glossy magazines are now beginning to use recycled paper and print less graphics in an attempt to control costs and respond to the public's interest in conservation.

Copyright Costs

Hardly anyone will give you a product free. Information on the network has value, and has development associated costs. Someone has authored it. Someone has collected and arranged it, and made it available in usable formats. It is likely that there will be so much information on the information superhighway that its value will be determined by how accurate it is, and how useful/accessible it is. The copyright rules now in force will probably be changed dramatically to attempt to accommodate the new ways information is being produced and made available to compensate information providers and protect them.

Service Costs

How long can you be without electricity or water? Time frames are as important to information access as more and more government activities and business and commerce is conducted electronically. Keeping the network running and the customer connected will be so important that information service executives careers will live and die based on the quality of network and node service. Service cost will continue to grow more expensive than the access costs.

Conclusion

How much does an information superhighway cost? No one knows. The real costs might be in the disruption and sociol problems with new skills and work that must be learned and accomplished in new and different ways, obsoleting jobs and industries. Initially, we may have great infrastructure, education, and network start-up costs. Long term we may expect to see great benefits, including a rapid growth in American economic and strategic competitiveness. In ten years the cost of investment may be returned 100 fold or more.

The authors volunteered to prepare this paper for the Oregon Telecommunications Forum. The views and representations in the paper are the authors' and not necessarily those of the Oregon Telecommunications Forum membership.

UNIVERSAL SERVICE
BACKGROUND PAPER

Prepared by: Betsy Newman, Medical Relations Director, Senate Majority Office and David Olson, Director, City of Portland Office of Cable Communications and Franchise Management, for the Oregon Telecommunications Forum, October 1994

The phrase, "universal service," was reportedly coined in 1910 by Theodore Vail, President of AT&T. Today, universal service is defined by the National Association of State Information Resource Executives as the concept that some specific minimum service is available to everyone everywhere--to every home, business, and institution. Anything less undermines the concept of universality.

The Clinton Administration has put a high priority on creating universal service in the United States. It is challenging private industry to provide free links from the information superhighway to every classroom, library, hospital, and clinic by the year 2000.

The question to be addressed in this paper is which advanced telecommunications services should be universally available. It is important that Oregon and the U.S. do not become societies of the information "haves" and "have-nots." Three criteria are used to determine what services should be on the list:

- What does Oregon need to stay competitive in terms of its economy, quality of life, and well-being of its citizens?
- What is affordable?
- What does the community want?

Using those criteria, a list of basic universal services has been identified:

1) Single party touch-tone telephone service
2) Digital switching
3) Access to broadband cable/phone/telecommunications
4) Standardization
5) Capacity setasides for public/governmental/non-profit use
6) Computers with modems in a variety of public places such as libraries

Single party touch-tone telephone service: You can't operate a computer on a party line. At the very minimum, single-party touch-tone must be extended to all areas of the state. Without this basic type of telephone service, other more advanced applications are impossible. This service is already so widespread, it is likely to be something phone companies can easily afford to offer.

Digital switching: A digitally-switched network provides very fast simultaneous transmission of voice, data, and images over a single conduit such as twisted pair, fiber, or coaxial cable. It enables the carriage of hundreds of simultaneous communications in seconds instead of minutes and through such means as "compression," allows this to occur in the same amount of space that previously could carry only one telephone conversation. Compared to traditional phone lines it is "faster and more."

Two examples of the applications of digital switching are transmission of x-ray images over phone lines and video-conferencing.

Access to broadband cable/phone/telecommunications: In the coming years there may be one or more wires into every home providing a variety of telecommunications services such as voice communications, data transmission, television programming, or interactive programming. Those wires may be provided by one telecommunications provider or several. For example, a phone company may provide phone service to homes or phone and cable service with some other company providing data transmission service. To meet the goal of universal service, all homes must have the potential to be wired for all telecommunications services.

Access to broadband high-speed telecommunications services has potential for substantially improving quality of life. Some of the possible applications of such technology include transmission of x-rays and other diagnostic images from one hospital to another, potentially boosting the level of medical care in remote areas.

Standardization: Universal service is meaningless without agreed-on national standards for equipment and technology. Citizens might otherwise not be able to adapt their equipment for use among different telecommunications providers.

Capacity setasides for public/governmental/non-profit use: Any component of universal service must provide for capacity at reduced rates for public services. An agreed-on funding mechanism must be provided.

Computers with modems in a variety of public places such as libraries: Even if the technology is universally available, it is unreasonable to assume that everyone will be able to afford a computer. Putting them in public places will help assure that access to the "information superhighway" is available to all. It would also have the added benefit of demonstrating to the public the potential uses of telecommunications.

Geography and economic factors cannot be barriers to universal service. As with capacity, setasides for public and non-profit use, an agreed-upon funding mechanism must be approved.

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GLOSSARY

Access: The ability of a user to enter a network.

Access Charge: Rates for use of local exchange facilities, especially for access to these facilities to provide long distance service. These charges may be imposed on end users or on long distance inter-exchange carriers who in turn pass costs along to end users. Telephone subscribers pay subscriber access charges to local carriers for access to the interstate public switched long distance network. Long distance carriers also pay carrier access charges to local telephone carriers for the use of local lines to complete long distance calls.

Access Line: The facilities between a telephone company service office and the customer's premise that are required to provide connection to the local and long distance net-works. This is also called a local loop.

ADSL (Asymmetrical Digital Subscriber Loop): A switching technology that requires no new technology on the part of the consumer. ADSL is currently being tested, and will be able to provide video, such as movies, over existing copper facilities on an "on demand" basis.

Aggregators: Businesses other than phone companies that lease phone lines and resell them at locations such as hotels, hospitals, motels and airports.

Analog Communications: A communications format in which information is transmitted by modulating a continuous signal, such as a radio wave. Voice and video messages originate in analog form since sound and light are wave-like functions; thus, they must be converted into digital messages in order to communicate along digital communications formats or media.

Archie: System which allows you to search indexes of file archives which are publicly available on the Internet. In other words, it allows you to do a keyword search of anonymous ftp sites.

Asynchronous Transfer Mode (ATM): A digital protocol for the transfer of data in the form of packets or cells over telecommunications facilities. Addresses are included as a part of the message, allowing for the automatic routing of the information without the use of switches.

Audio conferencing: Telephone contact between two or more sites, usually connected by means of a telephone bridge and via speaker phones. Unless video phones are used, there is no visual communication.

B Channel: A message bearing communications channel operating at 64 Kbps specified in the Integrated Services Digital Network (ISDN) standards. B Channels are used to digitally transmit speech, facsimile, freeze-frame video and data.

Backbone: The high density portion of the communications network.

Band: A range of radio frequencies between two defined limits. The term "band" is also used by regulators to establish a range of charges.

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Bandwidth: The range of frequencies that can be transmitted along a communications channel. Also the range of frequencies required to transmit a communications signal with undue distortion. Bandwidth is measured in Hertz, or cycles per second. The more information a signal contains, the more bandwidth it requires for transmission. For example, telephone conversations require only about 3,000 Hertz while television signals require a bandwidth of 3 million Hertz. The higher the bandwidth the greater the amount of information that can be transmitted in a given time.

Basic Exchange Digital Radio Service (BETRS): A rural communication service that transmit digitized communications using radio signals rather than wire or cable.

Basic Service: The dial tone and other essentials of phone service, exclusive of special options.

Basic Service Element (BSE): The fundamental building block for basic and/or enhanced services. Under Open Network Architecture rules, Bell companies must make BSEs available on an unbundled and non-discriminatory basis.

Basic Serving Arrangement (BSA): The physical transmission facility and central office switching functions sold by a BOC to enhanced service providers under Open Network Architecture. ESPs must buy BSAs in order to have access to BSEs.

Baud Rate: The speed of data transfer between computers (at which a modem sends and receives data), expressed in bits per second. The baud rate is the number of times per second that a signal is altered. Higher baud rates speed up communications while lowering telecommunications costs. Typical baud rates are 1200 bps, 2400 bps and 9600 bps.

Bell Operating Companies (BOCs): As a result of the AT&T divestiture, the original Bell telephone system was divided into 22 local Bell operating companies now providing local telephone service across the country. These companies are managed by the seven "Baby Bells," as regional holding companies for the BOCs. The BOC for Colorado is U S West Communications.

BITNET: (because it's time network) An international academic computer network which supports e-mail, mailing lists, and file transfer. Does not support remote login (aka telnet).

Broadband Communication: High frequency transmission required for video transmission. Fiber optic and coaxial can carry broadband communications; the copper wires traditionally used by telephone companies cannot.

Broadcast Television: Transmission of picture (video) and sound (audio) over standard UHF and VHF television channels. Interactivity between origination and reception sites is possible using telephones.

Bulletin Board System (BBS): A telecommunications service for sharing information. A Bulletin Board System usually consists of a personal computer connected to a telephone line by means of a modem running special software that enables the computer to receive, store and forward messages from people who use their personal computers, telecommunications software, and modems to communicate via the BBS. The systems may be run by individuals from their homes, by businesses, computer stores, corporations, or governmental agencies.

Carrier: Any company that is authorized by regulatory agencies to provide communications.

Cellular Telephone Service: Mobile telephone service using a series of transmitters in local areas or cells. The transmission changes frequency as the driver moves between cells. The system allows frequencies to be reused, thus providing much greater capacity that older mobile systems. Cellular telephone calls are connected into the public switched network.

Central Office: Telephone company facilities that house switching and related equipment, serving the immediate geographic area. The central office is the most immediate point of interface between the telephone company and customers.

Centrex: A service offered by telephone companies providing business customer direct inward dialing to their own lines allowing them to circumvent the public portion of the switching facilities. Centrex allows companies to more directly manage their telecommunications.

CLASS (Custom Local Area Signaling Services): A grouping of sophisticated new telephone services that rely on the Signaling System 7 network to provide information about the caller.

Client/Server Software: The model used for many of the popular Internet tools, such as Gopher, WWW, Archie and WAIS. The server is the software on the host computer which provides services to other computers. Server also may refer to the computer which has the server software loaded on it. A client asks a server to display a file. The server will then "serve up" the data to the client. The client software makes requests of the server.

Coaxial cable: A metal cable consisting of a conductor surrounded by another conductor (as in "cable TV"), which can carry video, audio, and data signals from point to point. TV transmission is in full motion. Commercial cable companies provide the service in most cases. Although cable technology is capable of transmitting two-way video instruction, most educational systems using cable are in a one-way video, two-way audio mode. Audio interaction is typically over telephone lines.

Codec (Encoder/Decoder): A device used to transform an analog input into a digitally encoded output, and which can also perform the reverse operation of turning a digital input into analog output; an analog/digital-digital/analog converter.

Common Carrier: A supplier that offers services to the public that are subject to oversight from federal and state regulators. These services are provided on a non-discriminatory basis.

Competitive Access Provider (CAP): A private telephone company that provides competition to local telephone service. Most CAPs are serving business areas, which are the most profitable. They are also known as MANs (Metropolitan Area Networks) and ALTs (Alternative Local Telecommunications Services).

Customer Premises Equipment (CPE): Customer owned equipment, ranging from simple single-line telephones to private branch exchanges.

Cream Skimming: Attempts to sell services only to the most profitable customers. Local telephone companies, which have universal service obligations, charge that companies engaging in bypass of the public switched network are essentially just "cream skimmers" that hurt the economic of providing universal service.

Data Compression: Reduction by various techniques of computer memory or transmission space required to handle a given amount of information. Compression makes it possible, for instance, to put 500 channels on a cable system designed for 70.

Dedicated Line: A private line for the exclusive use of the subscriber.

Deregulation: Removal or lessening of regulations governing a telecommunications service provider.

Detariffing: Removal of common carrier regulations by a regulatory agency. Detariffing is often used as an incentive for telephone companies to speed up network development.

Digital Communications: A communications format used with both electronic and light-based systems that transmits audio, video, and data as bits of information. Digital communications is particularly suited to data communications, since computers communicate and function digitally. Digital technology also allows communications signals to be compressed for more efficient transmission. Codecs (coder-decoders) are required for video and voice signals transmission in digital form, since video and voice are analog messages.

Digitalization: The process of converting analog information, such as voice and video messages, into digital signals.

Direct Broadcast Satellite (DBS): Full motion television programming transmitted via satellite directly to the user, who receives video and audio information using a satellite antenna or receiver dish less than 1 meter diameter. This is a one-way (outgoing from origination site) transmission. Audio interaction by students is through telephones.

Distance Learning: The use of telecommunications to offer instruction to students in different geographical locations at the same or different times. Also called Distance Education.

Divestiture: The break-up of the AT&T monopoly into 7 regional Bell operating companies, Bellcore, and 22 Bell operating companies. Divestiture resulted from the 1984 Modified Final Judgment, which settled the government's long-standing antitrust suit against AT&T.

Earth Station: The antenna and associated equipment used to receive and/or transmit telecommunications signals via satellite.

Electronic Data Interexchange (EDI): The use of computers and telecommunications technologies to process common transaction functions, such as invoices, shipping notices and bills, that traditionally have entailed transfer and processing of paper documents. With EDI, computers exchange information via telecommunications and process the information without the delay typically entailed with paper transactions. EDI improves efficiency and effectiveness of operations by empowering businesses to purchase supplies and to produce and distribute products precisely when and where they are needed.

Electronic Mail (E-mail): An application that lets users send messages from one networked computer terminal to another. Messages are stored kin users' "mailboxes" for retrieval on demand.

Emulation: The use of hardware and/or software that permits one kind of data terminal or computer system to mimic another kind of terminal or computer. Emulation is important for such services as videotex, where there are no governing standards.

Enhanced Services: Any service offered over common carrier transmission facilities which provides the customer additional, different or restructured information or permits customer interaction with stored information.

Equal Access: The ability to make a long distance call using a preselected long distance carrier by dialing 1 plus 10 digits (1 + dialing).

Expanded Area Service (EAS): Expanded area service; the ability to call an extended area for a flat monthly rate instead of paying a tool charge for each call.

Facilities: Physical components, such as transmission lines and switches, that are used to provide telephone service.

Federal Communication Commission (FCC): The agency empowered by law to regulate all wire and radio systems in the United States.

Fiber Optics: Hair thin, flexible glass rods that use light to transmit audio, video and data signals. Fiber optics are particularly suitable for digital communications since light impulses go "on" and "off" to transmit messages. Fiber optic cable has much higher capacity than copper wire or coaxial cable and is not subject to interference or noise. Fiber optics: a rapidly developing and emerging medium that transmits voice, full-motion video, and data by sending light impulses through ultra-thin Bass fibers. Fiber optics permits two-way, full-motion video and two-way audio interaction between participating sites.

Foreign Exchange (FX): An exchange service that uses a private line to connect to a subscriber's local central office in a community outside the subscriber's local calling area. With FX service, a phone number in the distant central office is made part of the subscriber's local service.

Freenet: Community-based bulletin board systems with e-mail, information resources and conferencing capabilities. Based on the public television/public radio model of community access and support.

Freeze Frame/Slow Scan: Still pictures (no motion) of instructional content are transmitted over regular telephone lines. The user must have special equipment that decodes the visual information onto a television monitor. The visuals are received in a "slow-scan" format--that is, a new picture can be replaced in set intervals ranging from eight to 45 seconds. Audio interaction, in this case, also occurs via telephone lines.

FTP: (file transfer protocol) A software program which allows you to transfer files from one computer to another. Facilitates the movement of large files very quickly over the Internet.

Gateway: Connection between networks using different protocols. The entrance point for a variety of electronic information services that can be digitally accessed by touch tone phone or computer. Also the connection between a telecommunications carrier and an information provider.

Gopher: Menu-based software which allows you to navigate across the Internet to access resources. This is public domain, client/server-based software.

Hertz: A unit of frequency equal to one cycle per second (cps). One kilohertz equals one thousand cps; one megahertz equals one million cps; one gigahertz equals one billion cps. Frequency measurement in Hertz is employed to define the bands of the electromagnetic spectrum that are used in voice and data communications, or to define the bandwidth capacity of a transmission medium.

Host-Remote Switch: A device that can provide local switching capabilities for communities local far from a telephone company central office (see Central Office), host-remote switching can improve quality of service for remote communities since local calls do not have to travel long distances, along which signals can be attenuated, to the central office to be switched. While the remote switch can perform most functions of a regular switch, it is dependent on a host switch typically found in a larger community.

Independent Telephone Company: A local exchange carrier that is not part of the Bell System of Bell operating companies (BOCs) and regional Bell operating companies (RBOCs).

Information Provider (IP): An entity that offers a telephone information service through numbers obtained from a local or long distance company.

Instructional Television Fixed Services (ITFS): ITFS is a one-way microwave technology capable of serving limited geographical areas (maximum distance is a radius of 20 miles). Both the visual and sound components of a program are transmitted directly to the user. Signals are received by a specialized antenna or receiver. Interactivity requires the use of telephones.

Integrated Services Digital Networks (ISDN): A protocol for high-speed digital transmission. ISDN provides simultaneous voice and high-data transmission along a signal conduit to users. Two ISDN protocols have been standardized: With narrow band ISDN, or 2B + D, two 64 kilobits per second (kbps) channels carry voice or data messages and on 16 kbps channel is used for signaling--carrying addressing and other call-related information; with broadband ISDN, or 23B + D, 23 kbps, channels carry voice or data messages and one 64 kbps channel is used for signaling.

Interexchange Carrier (IXC): A telephone company--such as AT&T, MCI or Sprint--that carries long-distance calls. IXCs are authorized by the Federal Communications Commission (FCC) to handle interLATA interstate traffic and can be authorized by state public service commissions to carry interLATA intrastate traffic.

Internet: Called the "network of networks," the Internet now connects well over 20 million people in over 100 countries. The Internet was created by the Advanced Research Project Agency of the Department of Defense in the late 1960s. Continuously upgraded ever since, the National Science Foundation (NSF) was granted permission by Congress in the 1980s to set up a network of supercomputer research centers, all on major university campuses. NSF created a system of funding to networking projects that would disseminate networking resources onto college and university campuses that had previously been excluded from the Internet. Thus, the precedence was set that now practically every four-year institution in the United States is connected to the Internet as are many high schools, community networks and individuals. Many private U.S. based networks have been established and are capable of receiving and sending information onto the Internet.

Kilobits Per Second: A unit of measurement for the speed at which information travels, Kbps-thousand bits per second. Also Mbps--Megabits per second, million bits, and Gbps--Gigabits per second, billion bits.

Lifeline: Fund to help low income telephone subscribers maintain access to basic local telephone service.

Link Up America: Program to provide federal assistance for half the cost of installation and deposit charges for residential telephone service, up to $30.

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Listserv: Subject-oriented electronic mailing list to which anyone on the Internet with electronic mail access may subscribe. A message posted to a listserv is received by all other subscribers to the list. Listserv also refers to the software that runs some mailing lists.

Local Access and Transport Area (LATA): LATAs were developed as a result of the divestiture settlement to define geographic areas within which the Bell operating companies (BOCs) can provide telephone service. The settlement allows BOCs to provide intraLATA service, but forbids them from providing interLATA telecommunications.

Local Area Network (LAN): Computers tied together for communications purposes in a limited geographic area.

Local Calling Area: The area within which a customer may make a call without incurring long-distance charges.

Local Exchange: The geographic area in which there is a uniform price for telephone service. More than one central office may serve a local exchange.

Local Exchange Carrier (LEC): A telephone company that carries local calls. In most exchanges the LEC is a Bell operating company, but hundreds of independent telephone companies are LECs. State public service commissions regulate the monopoly services of LECs.

Local Loop: The portion of the telecommunications network between customers' premises and the telephone company central office.

Low-Power Television: Broadcast medium similar to commercial television, except that the low-power signal limits the broadcast area. The technology permits one-way, full motion video. Audio interaction is by telephones.

Microwave: High-frequency radio waves used for point-to-point and omnidirectional communication of audio, data and video signals. Microwave frequencies require direct line of sight between sending and receiving station to operate. Obstruction distorts the signal. Like direct broadcast satellite, microwave transmissions require special transmitters and receivers. The transmitters and receivers must be in "line of Sight"--they must be aligned within sight of each other. Many microwave systems are capable of two-way audio and two-way video, full-motion transmission. Interaction between origination and reception sites occurs directly over the microwave system.

Modem (Modulator/Demodulator): Electronic device that sends data via telephone lines from one computer to another.

Modified Final Judgment (MFJ): The 1984 agreement between AT&T and the U.S. Justice Department, which settled the government's long-standing antitrust suit against AT&T and resulted in AT&T's divestiture (See Divestiture). BOCs cannot offer long-distance serve; and RBOCs cannot offer local telephone service.

Multiplexing: Analog multiplexing is the process of combining a number of individual signals - usually voice or television - into a single wide band channel for transmission. Digital multiplexing is the process of combing a number of signals - voice or data - into a common bit stream for transmission. Multiplexing is used to combine signals from many customers onto carrier systems. CATV uses multiplexing to place many television signals onto its facilities.

Narrow band Channel: A communications channel, such as copper wire or part of a coaxial cable channel, that transmits voice, facsimile or data at rates of kilobits per second, but not high speed data or video.

Network: A group of computers that communicate with each other and share applications and files.

Node: A point of interconnection to the network.

Open Network Architecture (ONA): A concept intended to permit all vendors of basic or enhanced services, including the phone company itself, to procure basic network functions and interfaces on an unbundled equal access basis.

Other Common Carriers (OCC): These companies, which include specialized common carriers, domestic and international record carriers and domestic satellite carriers, have been authorized by the FCC to provide communications services in competition with the established telephone common carriers.

Packet Switching: The process of transmitting digital information by means of addressed packets - which include data, call control signals, and error control information - so that a channel is occupied only during transmission of the packet. In contrast, data sent using modems occupies a circuit for the entire duration of transmission, even when no data is actually traveling over lines. Using packet switching, various packets of information can travel along different routes on the network, allowing the carrier to optimize network capacity.

Personal Communications Network (PCN): A proposed network composed of a variety of wireless services including cordless telephones, wireless private branch exchanges, and wireless local area networks.

Plain Old Telephone Service (POTS): Traditional, voice-based telephone services unenhanced by new network elements such as custom calling or CLASS.

Point of Presence (POP): The point at which an interexchange carriers' circuits connect with local circuits for transmission and reception of long distance calls.

Price Cap: A regulation that sets the maximum price telephone companies can charge for a designated group of services. The set price changes over time, based on inflation and targets for improvements in productivity.

Private Branch Exchange (PBX): A small telephone switch that typically serves extensions in a business or campus arrangement and also provides interconnectivity with the public network. A PBX offers similar capabilities as Centrex, except the equipment is owned by the customer rather than leased from the telephone company.

Public Switched Network: The universally accessible, ubiquitous telephone network, to which any user can connect through the local exchange companies. See also "Universal Service."

Public Utilities Commission (PUC): A state regulatory body.

Rate of Return: A method of regulation that defines the total revenue a telephone company requires to provide services. The revenue requirement includes operating expenses, depreciation, and taxes, and a "fair" return on its capital investment ("rate base").

Regional Bell Operating Company (RBOC): One of the seven companies formed by the AT&T divestiture, including Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell, and U S West.

Remote Host: The computer or computer network which has resources which can be accessed by another computer on the Internet. These hosts are usually accessed via telnet. Example: when you telnet to another library's online catalog, the remote host is the computer on the other end which supports that catalog.

Rural Area Networks (RANs): As conceptualized by ONA, RANs would be shared-usage networks, configured to include a wide range of users in rural communities. RANs would allow rural communities to pool demand for advanced telecommunications services in order to justify and share cost of sophisticated equipment that individual users could not otherwise afford or fully utilize. RANs would not be isolated "technology islands," but would connect rural areas with the rest of the world.

Rural Electrification Administration (REA): A U.S. Department of Agriculture agency charged to foster technology deployment through a low-cost Federal loan program and the provisions of in-kind services.

Satellite: A communications relay device orbiting the earth to permit communications among earth stations.

Signaling: The act of sending messages between network switches and/or control points that convey information about circuit status, traffic loads, call routing and other immediate aspects of network operations.

Signaling System 7 (SS7): A control system for the public telephone network that allows telephone company computers to communicate directly with each other for routing calls, using signaling circuits separate from circuits used for the telephone call themselves.

SONET: (Sychronous Optical Network) Refers to a transmission standard for fiber optic media.

Subscriber Line Charges (SLC): Subscriber line charges are a convention adopted after divestiture to defray the portion of cost of long-distance calls that use local access plant. Prior to divestiture of the Bell System, prices for long-distance service were set artificially high and extra revenue defrayed costs of local service and kept local rates low. The Federal Communications Commission implemented SLCs after divestiture when this cross-subsidization was no longer possible because long-distance service became competitive.

Switch: A mechanical or solid-state device that opens or closes circuits, changes operating parameters or selects paths or circuits.

Switch Multimegabit Data Service (SMDS): SMDS is a highspeed, fast packet-switched service provided in a campus or ring, type arrangement within a 50-mile radius.

Systems Operator (SysOp): The person who manages the software and hardware used in a telecommunications system or BBS.

T1 Circuits: T1 circuits have 24 channels--each carrying 64 kbps of information and operating at a capacity of 1.544 megabytes per second (Mbps). T1 standard for transmission in North America.

Tariff: A rate, charge or condition approved by a regulatory agency for a regulated utility.

TCP/IP: (transmission control protocol/internet protocol) The sets of standards on which the Internet is based. Most importantly, they allow data to pass between the variety of networks which make up the Internet.

Telecommunications: Any sending or receiving of information as signals, sounds or images by electrical or electronic means.

Telecommuting: Working outside of a traditional office by use of telephones, modems and/or faxes.

Teleconference: A conference of three or more people at two or more locations linked by telecommunications. Can involve audio, graphics, computer communications, and/or video.

Telemedicine: Use of telecommunications for medical diagnosis, patient care, and health education.

Telnet: Software program which allows you to log in to remote computer systems on the Internet. The systems you log in to are often referred to as remote hosts.

Telephone: Telephone lines are now capable of transmitting more than voice. With appropriate equipment, they can also transmit still-frame or full-motion television images and data (printed) information. Telephones, and the use of telephone lines, are, in fact, a central component of every interactive distance learning system.

Telex: A public switched network connecting teletypewriters or other devices transmitting at 50 bits per second.

Transponder: The device in an orbiting communications satellite that receives a signal from earth, translates and amplifies the signal, and retransmits it back to earth.

Twisted Pair: A pair of insulated metal wires twisted together, but not covered with an outer sheath. The term is also used to generically denote those segments of intra-building communications wiring arrangements that are not microwave radio channels, metallic main telephone cables, metallic coaxial cables or fiber optic cables.

Unbundling: The separate pricing of hardware, software and related services so that vendors can buy only those services they need. Unbundling is a key to achieving the goal of open network architecture.

Universal Service: A policy associated with the Communications Act of 1934, which granted the AT&T monopoly for telephone service in the United States, to provide telephone service to all who wanted it at a reasonable price, or providing service to virtually every household.

Unix: Computer operating system which played a key role in the development of the Internet.

Usenet: (aka netnews) This is an informal group of electronic systems which uses subject-specific groups, referred to as newsgroups, to exchange news and information on a vast array of topics. There are currently over 4,000 Usenet newsgroups.

Value Added Network (VAN): A data communications system in which special features such as protocol conversion of database access are added to the underlying transmission capabilities.

Veronica: (very easy rodent-oriented net-wide index to computerized archives) Performs a keyword search of gopher menus and titles. Search results are displayed via a newly created gopher based on your Veronica search.

Vertical Blanking Interval (VBI): An unseen part of the standard broadcast signal used to transmit television. Using special equipment, this signal can be encoded and decoded to transmit additional information. VBI is frequently used for freeze-frame or slow-scan transmission of visual information. Audio interaction between sites occurs over telephone lines.

Video conferencing: A two-way video/audio service using telecommunications facilities that allow for real-time transmission at different levels. Video conferencing requires a high level of bandwidth, generally above T-1.

Videotex: Electronic delivery of text and graphic information to a computer monitor or television set. Videotex is now more commonly referred to as interactive online services.

Virtual Networks: Virtual networks establish logical, temporary connections as opposed to dedicated ones. From the user's perspective, they are similar to private networks.

Voice Mail: A voice messaging system in which spoken messages are recorded for later play back or transfer to others.

VSATs: Very small aperture terminals, satellite receive dishes, approximately 1.8 to 2.4 meters in diameter, capable of sending and receiving voice, data and/or video signals. VSATs can transmit over wide areas by relaying to satellites.

Wide Area Network (WAN): Data communication networks that provide long-haul connectivity among separate networks located in different geographic areas. WANs make use of a variety of transmission media, which can be provided on a leased or dial-up basis. WANs can also be privately owned.

Wireless Communications: A system that uses radio transmitters and receivers in place of wire lines which, when connected to the evolving public switched network, provides comprehensive telephone service to customers.

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TELECOMMUNICATIONS IN OREGON
Background Legislation and Studies

* * *

SOURCE: **ORS Chapters 756 and 759, Laws Relating to the Public Utility Commission of Oregon**

VISION: The PUC is charged with protecting the customers of telecommunications utilities from unjust and unreasonable exactions and to obtain for them adequate service at fair and reasonable rates.

GOAL: The Legislature has declared that it is the goal of the State of Oregon to secure and maintain high-quality universal telecommunications service at just and reasonable rates for all classes of customers and all citizens of the state and to encourage innovation within the industry by a balanced program of regulation and competition.

* * *

SOURCE: **1989 OREGON LAWS; CHAPTER 972 (SB 203)**

VISION: To promote economic development by providing educational programs, worker training and retraining services and a telecommunications system throughout the state.

GOALS: Create Oregon Ed-Net, an integrated state-wide educational telecommunications network.

Establish policies and procedures for managing and financing Oregon ED-NET services.

Encourage the establishment of, or cooperation with, an independent nonprofit corporation in order to facilitate receipt of grants and contracts from foundations and other persons.

To not compete with telecommunications utilities for transmission of noneducational communications.

That user fees established by the board shall be designed to cover the long run incremental costs of the network.

WHAT'S HAPPENED:

Promote Economic Development: Oregon ED-NET serves over 300 organizations in education, government, business and healthcare with courses, job training, and retraining, meetings, medical consultations, hearings and informational programs.

Create an Integrated Statewide Telecommunications Network: Oregon ED-NET has created a network that integrates video, voice and data communications in three networks that serve the entire state:

- Network I provides integrated video and voice communication from over 15 program origination sites to over 225 receive sites located in 35 countries.
- Network II provides two-way video and audio to 37 sites located in all regions of the state and interactive video and audio to all Network I sites.
- Network III, called Compass, provides computer and modem access to data services (E-mail, bulletin boards, conferencing, Internet access) via local dial-up lines in 21 communities (serving over 80% of the population).

Policies and Procedures for Managing and Financing Oregon ED-NET:

- Oregon ED-NET has a 9 member policy board, a staff of 10 FTE and a reporting relationship through the IRMD Division of the Department of Administrative Services.
- Procedures are in place for delivering services on a user fee and membership fee basis.

Non-Profit Corporation: Oregon ED-NET has not needed to establish a non-profit corporation in order to be eligible to receive grants and contracts.

Not Compete With Telecommunications Utilities: Oregon ED-NET programming is focused on meeting education and economic development needs.

User Fees: Oregon ED-NET charges fees to users that are designed to cover the long run incremental costs of the network.

SOURCE: TELECOMMUNICATIONS: OREGON'S NEXT TRAIL (April 1991)

A report to Governor Roberts prepared by Task Force on Telecommunications Members:

Ron Adams	Marylhurst College
Jerry Bennett	Linn-Benton Ed. Service District
Ron Eachus	Oregon PUC
Lisa Hoesel	US Bancorp
Dan Mulholland	Lane Council of Governments
Ed Parker	Parker Telecommunications
Ruth Stockdale	Timberline Software

VISION: Oregon will do the necessary planning inside government and across Oregon to take advantage of the promise of telecommunications and other information technologies.

GOALS: Elevate telecommunications to a stature equal to education and transportation.

Establish a strategic plan and articulate policy and goals which give needed direction, cohesion and context to how we think about telecommunications and how we invest in this infrastructure.

Increase citizens' access to public information and services without regard to geographic location or income.

Establish a full set of performance measures for tracking the health and capability of its telecommunications infrastructure.

Establish a central authority for coordinating, evaluating and setting priorities for the state's telecommunications efforts.
Formalize the cooperative/peer review role performed by the inter-agency Telecommunications Advisory Committee.

Establish criteria for judging the merit of state agency telecommunication projects that assess the project's impact on the community of state and local agencies, the citizens they serve, and the public switched network.

Long Term Goals:

- Establish a Task Force under the direction of the Governor's office to develop telecommunications policies and goals for the state as a whole.
- Conduct a study to determine the potential for telecommuting in the state's work force and to determine the changes in personnel practices necessary to enable new work arrangements that take advantage of telecommunications technology.
- Implement statewide electronic mail to link state agencies, cities, counties and Educational Service Districts and to interconnect with public switched electronic mail services by 1995.
- Extend state government's emerging standards in data processing, data base management, and network management to cities, counties and Educational Service Districts to allow easy sharing of information resources and the creation of information alliances.

WHAT'S HAPPENED: SB 1208 and SB 1210 were passed by the 1991 Legislative Assembly to promote these goals

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SOURCE: **1991 OREGON LAWS; CHAPTER 779 (SB 1208)**

VISION: Affordable access to information is necessary for Oregon's economic development and for improvement in the quality of life of all Oregonians.

GOALS: That all Oregonians should have affordable access to an integrated private and public telecommunications infrastructure that provides voice, data and image information services.

That the Economic Development Department shall research and develop recommendations for a Strategic Telecommunications Infrastructure Plan for Oregon that includes:

- Goals for the telecommunications infrastructure in the year 2000 and 2005.
- Goals for the education of Oregonians in telecommunications applications and for the equipment in schools to provide such education.
- The role of the state government network procurement in the process of providing public telecommunications infrastructure that will provide access to applications and stimulate economic development.

That the Economic Development Department shall appoint and consult with a specific advisory committee.

That the Executive Department (Administrative Services) will develop a report that provides a description of the current telecommunications systems and actions and future plans to assure that Oregonians have affordable access to public information.

WHAT'S HAPPENED:

The Economic Development Department organized an advisory committee and contracted with a consultant to develop a strategic plan for telecommunications in Oregon called "Oregon Connects".

The Executive Department (now Department of Administrative Services, DAS) established an Information Systems review committee and developed a report entitled *"Report and Recommendations from the Information Systems Review Committee"*. (February 1992) This report identified three key recommendations:

1 - Establish an Information Resources Management Policy Board
2 - Establish a Data Network Management Structure
3 - Take First Steps to Create a Coordinated Network

All three recommendations have been implemented.

●-----------------------●

SOURCE: 1991 OREGON LAWS; CHAPTER 779 (SB 1210)

VISION: Information resources management for state government that will promote:

- Improved productivity of state workers.
- Better public access to public information.
- Increased effectiveness in the delivery of services provided by the various agencies.
- Enhanced development of the telecommunication infrastructure available to the public.

GOALS: The state shall develop management procedures to assure effective information resources exist and that they include:

- A specific statewide strategic plan, including management and technical policy.
- Communications systems and information resources that respond to the management information needs of agencies and programs.
- Consideration of the impact of information resources management activities on the development and vitality of telecommunications infrastructure available to the public.
- Rules, policies and procedures to promote electronic communication and information sharing among state agencies and programs and between state and local governments, and with the public.

WHAT'S HAPPENED:

Strategic Plan for Information Resource Management (January 1992):

A Strategic Information Resources Management Plan was developed to articulate WHAT needs to be done. Executive Department Information Systems Division worked with agencies to identify statewide goals, desired results by the end of the decade, and suggested strategies for the following Information Resources Management disciplines:

- Data management.
- Technology environment.
- Customer service and public access.
- Data, network, and computer security.
- Innovation.
- Preparing the state's workforce for evolving Information Resources Management roles and responsibilities.

1993 -1995 Agency Information Resources Management Plans (May 1992):

Agencies provided the Executive Department with the following information:

- Agency business agenda, goals, and objectives.
- Customer service and public access initiatives.
- Data management activities and a data inventory.

- Technology profile and plan, installed base, planned acquisitions, and strategies to migrate to state's standards.
- Staffing needs and training/education plans.
- Information Resources Management project summaries and priorities.

Information Technology Policies and Standards (Fall 1992)

Executive Department Information Systems Division worked with agencies to develop standards and policies for the following:

- Policy and standard for information technology architecture.
- Electronic mail standard.
- Standards for relational database management system.
- Local area network standards.
- Network communication protocol standards.
- Standards for common computing operating environments.
- Graphical user interface guidelines.
- Electronic data interchange standard.

Tactical Plan for Information Resource Management (November 1992)

A Tactical Information Resources Management Plan was developed to articulate HOW we plan to accomplish the goals outlined in the Strategic Information Resources Management Plan. The Executive Department Information Systems Division worked with agencies to identify strategic initiatives that will move the state toward the desired outcomes goals. In the tactical plan, the Executive Department identified initiatives in the following areas:

- Technology environment.
- Corporate data management.
- Enhanced network services.
- Customer service and public access.
- Corporate partners-identify and leverage key relationships.
- Innovation and education.

* * *

SOURCE: OREGON CONNECTS (September 1992)

A report to the Oregon Legislative Assembly, Committee on Trade and Economic Development prepared by SRI International for the Oregon Economic Development Department. Advisory Committee members:

Jamie Albert	OR Institute of Technology
Charles Allcock	World Trade Center
George Beard	Dept. of Administrative Services
Terry Chadwick	Intn'l Trade Institute
John Dailey	Bear Creek Corporation
Hon. Scott Duff	State Senator - Adams
Ron Eachus	Oregon PUC
Oren Floyd	United Telephone
Lisa Hoesel	US Bancorp

Chuck Lenard	US West
Rick Levine	Chemeketa Comm. College
Bill Luce	GTE
Pete Mackie	Sequest Software, Inc.
Cathi Millar	Cellular One
Ed Parker	Consultant
Kirk Richardson	Teledyne Wah Chanc
Deanna Robinson	University of Oregon
Mike Sheehan	Scappoose
Hon. Tony Van Vliet	State Representative - Corvallis
Pete Wells	Umatilla Co. Brd. Cmmssn
Duncan Wyse	Oregon Progress Board
Dr. William Yasnoff	OR Health Sciences University

VISION: Ensure that rural and urban Oregonians have both affordable access and adequate support to make effective use of voice, data and image information services for meeting their economic development and quality of life aspirations.

GOALS: Expand citizen access to government information that helps meet economic and quality of life needs.

Make information and telecommunications more "user friendly" or applicable to citizen needs.

Increase citizen involvement with enhanced telecommunications services to help meet their needs in new ways.

Expand business-consumer interaction beyond basic voice communication to improve customer service and stimulate new business growth.

Increase the velocity and quantity of business-to-business interactions to remain competitive in the global economy.

Increase business usage of external information to gain competitive advantage.

Disperse employment opportunities statewide via telecommunications.

Increase local availability of quality health care to all areas of the state.

Ensure access to quality education in all areas of the state.

Help Oregonians develop information-age problem-solving skills.

Long Term Goals:

- A new public-private vehicle to promote collaborative action in Oregon to increase affordable access and user support in telecommunications.
- A new approach to government procurement to encourage infrastructure investments that meet government needs while also supporting Oregon's telecommunications vision.

- A new focal point for state government telecommunications to coordinate management of information resources and efforts to improve citizen access to government.

WHAT'S HAPPENED:

Oregon Connects called for creating a new entity during a session that necessitated budget reductions. The Legislature did not craft legislation directly from the vision and goals of Oregon Connects.

A statewide electronic mail system was developed that consolidated 28 independent electronic mail networks. This resulted in improved interagency communications and Internet access.

State agencies formed a partnership called "Oregon Online" to facilitate access to state government information via Internet.

The Information Resource Management (IRM) Council was created under SB1130 to serve as a focal point for the management of state government information resources.

* * *

SOURCE: **1993 OREGON LAWS; CHAPTER 724 (SB 1130)**

VISION: State government telecommunications networks will be designed to provide state-of-the-art services where economically and technically feasible, using shared, rather than dedicated, lines and facilities.

GOALS: The Department of Administrative Services (DAS) shall, when procuring telecommunications network services, consider the achievement of the economic development and quality of life outcomes contained in the Oregon benchmarks.

Establishment of the Information Resources Management Council to provide policy direction for and coordination of information technology for state government.

Adds telecommunications services for all state agencies within the management and control of DAS.

WHAT'S HAPPENED:

The Information Resources Management Council has been created, a charter developed, and the Council is meeting quarterly.

DAS Telecommunication Services Section has been placed under the management structure of the DAS Information Resources Management Division (IRMD) and all telecommunication products and services acquisitions are reviewed and approved by the division.

* * *

OREGON BENCHMARKS

Standards for Measuring Statewide Progress And Government Performance

Report to the 1993 Legislature

Telecommunications	1970	1980	1990	1992	1995	2000	2010
56. Percentage of Oregon households with single-party, touchtone-capable telephone service		65%	85%	92%	98%	99%	99%
57. Percentage of Oregon telephone lines that can reliably transmit data at medium speed		80%	97%	97%	100%	100%	100%
58. Percentage of Oregon households with personal computers at home who send and receive data and information over telecommunications				10%	20%	50%	75%
59. Percentage of Oregonians with access to high speed- multichannel telecommunications lines				0			

56. Percentage of Oregon households with single-party touchtone-capable telephone service
Explanation: This benchmark measures the capability of Oregon households to use advanced, interactive telecommunications services and enhanced 911 emergency services (from which operators can directly identify the household calling in an emergency). *Rationale*: Modern telecommunications infrastructure is becoming an important factor in business and government operations. More and more business and public services are available through such infrastructure. Availability of telecommunications is important to the development of many businesses and public services. *Data source*: Oregon Public Utility Commission, Telecommunications Division.

57. Percentage of Oregon telephone lines that can reliably transmit data at medium speed
Explanation: This benchmark measures the extent to which Oregon's public telecommunications switched network is able to reliably transmit medium-speed (1200 baud) data. Currently, standards required by Oregon Public Utility Commission tariffs require nearly all telephone lines in the state's network to transmit medium-speed data, but the network does not always meet the standards. *Rationale*: The telecommunications infrastructure in Oregon is critical to economic growth and expansion. Facsimiles and data are now transmitted over telephone lines; telecommunication lines are no longer solely used for voice-to-voice communication. *Data source*: Oregon Public Utility Commission, Telecommunications Division.

58. Percentage of Oregon households with personal computers at home who send and receive data and information over telecommunications
Explanation: This measures the number of households with computers and modems (which connect a computer to the phone system). *Rationale*: As the costs of manipulating and transmitting data declines, more and more households will benefit from access to data bases, electronic mail and other electronic services. The more people who connect into these services, the more data bases and opportunities for communications will emerge. A telecommunications task force recently concluded that accelerating this process will increase productivity and benefit Oregonians. *Data source*: *Oregon Values Study* conducted for the Oregon Business Council.

59. Percentage of Oregon Households with access to high speed-multichannel telecommunications lines.
Explanation: This measures the number of homes households with telecommunications lines such as fiber optics or Integrated Services Digital Network (ISDN) that can transmit data and video as well as voice services. *Rationale*: While this service is not available today, high speed transmission will become the high speed highways of the information age. While it is too early to set specific targets, Oregon's goal is to make this service available quickly to give the state a competitive edge at attracting knowledge workers and bring the productivity that such services can provide. *Data source*: The Public Utilities Commission will work with the telecommunications company to gather the data.

APPENDIX
THREE

A PARADIGM SHIFT IN K-12 EDUCATION

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"It is lamentable, utterly unjust and insulting that while all men are admitted to God's theatre, all are not given the chance of looking at everything."

These words were penned in the early 17th century by John Amos Comenius and they describe an inclusive philosophy of education which has never really been implemented. Instead, education has focused intensely upon the theme of "educating each according to their needs." Ironically, K-12 education is now in a position of reviving this old idea through the use of new technology-the Internet.

As civilization grew progressively more technical, education has moved along an evolutionary path dangerously close to that predicted in 1964 book "The Technological Society," in which Jacques Ellul writes, "Education will no longer be an unpredictable and exciting adventure in human enlightenment, but instead an exercise in conformity and apprenticeship to whatever gadgetry is useful in the technical world."

Yet, it is precisely the proper and effective use of today's technical gadgetry, the high speed information network, that can foster a paradigm shift in K-12 education. High speed network connectivity will allow the K-12 classroom a vast array of resources, particularly in the sciences.

Traditional barriers between student, teacher and professional researcher will erode, replaced by a learning community of individuals who are collectively interested in a particular subject. Herein lies the paradigm shift. The keeper of the knowledge will no longer be the individual K-12 teacher-now students will be able to access and interact with a diverse and distributed knowledge base. Professional researchers can make their real data available to this learning community and science can be taught as a discovery process rather than a collection of facts "known" about the physical world. This approach duplicates what the professional scientist does and can go a long way towards improving science education.

The benefits of this electronic partnership between the university and the K-12 community are potentially enormous. The recent celestial event involving the crash of comet SL9 into the planet Jupiter was a wonderful demonstration of how the Internet is used as a vehicle to distribute real and live data to a mass audience. Another exciting application is NASA's Mission to Planet Earth which promises to deliver gigabytes (roughly 100,000 printed pages of information per gigabyte) of environmental data across the NASA Science Internet to university researchers who then can pass it on to the K-12 community. As just one example, the ozone depletion problem can be studied in real-time and students can inspect the latest data themselves rather than having the problem compressed into a few media sound bites.

These technological breakthroughs and educational links between universities and K-12 schools underscore the value of higher education, debunking the perception held by some that professors exist in ivory towers, too preoccupied with themselves or their research to pay attention to the outside world. The electronic superhighway will increasingly allow professors to share their research and foster an excitement for learning among interested students, and in this process they can also help K-12 teachers navigate quickly through the vast and often times confusing information highway. Thus, through this partnership, the "looking at everything" ideal becomes more and more real with seemingly endless possibilities for exploration, dialogue and learning. Society's challenge will be to provide schools and universities with the resources and support they need to be full and equal partners in this new era.

LOCAL K12 PRODUCTION NETWORKS

The resources to facilitate this paradigm shift locally have been under quiet development for the last year at the University of Oregon. These resources have been developed to be delivered via Mosaic, which is a tool that acts as a multimedia browser of the Internet. Through this browser, text, graphs, images, sound, animation, and live audio and video can all be delivered to a K-12 classroom.

A Multimedia Internet Laboratory has been created on the UO campus to introduce K-12 and University faculty to the kinds of network resources which have been developed for classroom application. This lab serves as a scale model for fully functional Internet connecivity to a K12 school. In this laboratory, faculty can explore discipline specific material and shared curriculum development in an effort to reach a more global audience. K12 teachers and University faculty can use Mosaic as an organizational tool to jointly develop curriculum modules and receive feedback in almost real time. A local example of this now exists has a high speed network now links the university directly with the Albany and Springfield school districts. This new distance-learning tool provides K-12 teachers remote access to multimedia course materials around which they can personalize their own curriculum. And in the near future it will be possible for a classroom to remotely use a scientific instrument to acquire data by accessing the 32-inch telescope at the UO Pine Mountain Observatory near Bend.

These developments are made possible because the state of Oregon has been selected by NASA to construct a very high speed (ATM) network called project NERO for the express purpose of delivering educational and research material to a wide community. The Albany and Springfield School Districts are current NERO testbeds. The Pine Mountain Observatory (see below) will be another test bed. In addition, corporate donations from SUN and NCD are being used to setup a high speed Public Internet access display at OMSI. All of these projects are happening now and they all represent different pieces of a production network. The main educational server that houses the multimedia courseware is located at the University of Oregon and is run out of the Physics department. Materials are constantly being added. The relevant URL is http://zebu.uoregon.edu.

A REMOTE SCIENTIFIC INSTRUMENT FOR STUDENT USE CONTROLLED OVER A NETWORK: - THE NETWORKED TELESCOPE

OVERVIEW

Most all scientific research is now done from the desktop WorkStation of the individual scientist. In many cases, this includes the acquisition of the data itself, across the INTERNET. An excellent example of this process is provided by modern day astronomy and digital imaging devices. As an example application, we propose to use a real telescope, with digital camera, as a network device which will allow students in a remote classroom to acquire and analyze real data. In this way, students can go through the same set of procedures that a scientist does in the analysis and eventual publication of the data. This program would be unique in the nation, in that a large telescope is used, and would clearly show the educational power that high speed networking can provide.

THE PINE MOUNTAIN OBSERVATORY

The Pine Mountain Observatory is owned, operated and maintained by the University of Oregon. The observatory is located 32 miles S.E. of Bend, Oregon at an elevation of 6300 feet. Three domes are on the site which contain telescopes of aperture diameters 32, 24 and 15 inches. In fact, the 32-inch telescope may well be the largest telescope in the world which offers regular public access. Due to dramatic decreases in the cost of computing and digital imaging devices, a greatly expanded program in public education in Astronomy is now possible. Currently at the observatory we offer an Electronic Universe program in which members of the public can actually take a digital image home with them.

This existing program could be effectively coupled with the high bandwidth network connectivity to make possible remote observing at any centrally located facility which has an INTERNET connection. Such a service would have great educational value for both the general public and the students in the state of Oregon. The University of Oregon is willing to offer this resource as a testbed for educational applications of networking.

EDUCATIONAL UNDERPINNINGS

It is envisioned that the Pine Mountain facility will serve as a remote scientific laboratory that will serve as a supplement for astronomy classes, no matter where they are taught in the state. There is a great deal of interest in astronomy and it perhaps is the best medium whereby science can be taught as a discovery process. Our proposed use of a live facility is a much superior alternative to putting students and teachers in front of a PC running some inferior commercial software for the purposes of analyzing canned data. In the proposed system, their will be a scientist in charge to ensure that real experiments using real data can be conducted by interested students.

There is a tremendous potential offered by a high speed network to deliver real science to a remote audience. The ability to perform unbiased and accurate observations is crucial to scientific advancement. If we are to develop a scientifically informed public that has the ability to objectively analyze important issues (such as environmental ones) we need to promote awareness of how science is done and cultivate the spirit of inquiry in people of all ages as well as skepticism. Moreover, failure to understand this central concept obscures the real nature of science as being a discovery process. Rather, science becomes a collection of 'facts' which we have learned about the physical world. This serves to perpetuate the common misconception of science; namely that it is a collection of rigorous facts, boring in its methodology, with little relevance to society. Such a total misrepresentation of science to the general public easily leads to gullibility in terms of accepting scientific data/theory as truth.

It is clearly in the National interest to formulate and practice an effective strategy for deterring this view of science and revealing the true nature of science as a discovery process. One effective strategy is to make science more exciting and hands-on. All of us, regardless of our level of intellectual sophistication are intrinsically excited and curious when we discover (see or observe) something for the very first time. This excitement generally translates into motivation to learn and it is a skill which we should never lose. Children enter this world wide-eyed with excitement about discovering everything that is in it. Why should such excitement for discovering the natural world diminish over time? With the proposed high bandwidth connection to what is essentially now a digital astronomical camera, we can indeed serve science as it really is, a discovery of the unknown. Indeed, imagine the excitement this project can generate when some classroom can watch the moon literally drift across their screen.

IMPROVING SCIENCE EDUCATION: TRAINING TEACHERS TO EFFECTIVELY UTILIZE NETWORK RESOURCES IN THE CLASSROOM

High Bandwidth electronic networks offer the possibility of forming learning communities of educators who can share and develop courseware. The process can be highly interactive and feedback from the students can be integrated into improving the content. Most importantly, this network facilitates educational outreach activities between Higher Education and Secondary School systems. Physical distance is no longer an obstacle in having University level resources and personnel delivered to the local K-12 classrooms. However, none of this potential electronic partnership between Higher Ed and the Secondary Schools, as well as the development of a more dynamic curriculum, will ever occur unless teachers understand the technology and are enthusiastic about its implementation.

If information technology is to enhance educational quality and productivity, the design of technological solutions to educational problems must take into account the human dimensions of teaching and learning. The challenge is to train teachers in the use of the Internet as an effective two-way educational tool which will allow joint curriculum development, exchange of multi-media based information and frequent communication between K-12 teachers and university faculty and/or research personnel. Recent advances in information exchange using the Internet now make it possible to deliver full multi-media presentations to non-local classrooms.

The primary delivery tool is a Public Domain software product called Mosaic. Mosaic runs on all platforms and works on the principle of hypertext for easy navigation. Text, images, animation and sound can all be delivered to the remote desk top. Mosaic clients are linked together through the World Wide Web (developed at the CERN High Energy Facility in Geneva) so that anyone in the world with an Internet connection can access any material that is made available.

There has been a national call for improvement in teacher productivity as well as student mastery of subjects. This is especially critical in the area of science education.

Teacher training in the use of electronically available databases is an integral part of realizing this improvement in productivity. Moreover, by using Mosaic as an organizatio-nal interface, it will become possible for science teachers or teachers with a science module to incorporate materials delivered over the Internet to enhance and supplement the curriculum.

The effective use of network resources allows for a scientific curriculum which is based on real analysis of real data that promotes self-discovery. The first step towards realizing this potential is to establish the necessary teacher training program to foster communication between secondary science school teachers, to allow interaction between them and University personnel, to be exposed to the vast array of scientific information which is already available on the Internet, and finally to teach them to use existing tools to develop their own lesson plans. This development can either be done on the individual level or by teams of teachers.

These basic objectives can be achieved by meeting the following goals:

1. to provide a set of self-contained exercises that are centered around an electronically accessible (through Mosaic) digital archive of images,graphs,text,sound,etc.. This will assist the students in developing mastery of the subject at their own pace. Real life examples of this can be found at http://zebu.uoregon.edu.
2. to provide educators with a readily accessible and updated data base of the very latest scientific results. An astronomical example of this is the archive of images of Supernova that have recently occurred. These images readily show how Supernova brighten and then fade with time and they represent real scientific data taken by real scientists now made directly available to students.
3. to provide an interactive forum, through the computer network, for asking questions and receiving feedback from experts in the field. Students can remain anonymous which always aids in a frank and honest discussion. Various professional colleagues national labs have volunteered some "e-mail" time for this project.
4. to establish a Pilot project to: introduce, train and educate local area K-12 science teachers about the resources of the Internet and how an interactivecurriculum can be built around those resources

5. to develop a set of questions for the students that require searching the Internet for the material which is most relevant to the question. This is kind of an Internet scavanger hunt that both entertains and guides the user. The UO Physics Dept Web server can easily be configured to point at resources to guide the students in their quest for source material.
6. to develop and offer a fully integrated set of educational resources in the area of environmental science. Currently one can get up to date information on the distribution of ocean temperature, the size of the ozone hole, the latest earthquakes, severe weather, etc., over the Internet. More and more remote sensing material is being made available and NASA's project EARTH will almost certainly make heavy use of the Internet (through the Nasa Science Internet) as the delivery vehicle of the information to the public. Teachers need to understand how to rapidly find this material and access it in a way that is conducive for learning activities.

The development of a state wide network to allow teachers to work in curriculum development teams has a number of positive attributes:

1. This would provide a high-profile, high-visiblity outreach program from the State Universities that would facilitate shared resources and joint curriculum development of core courses. Students at local schools, in specific cases such as astronomy and environmental sciences, would now have access to more resources than their local school can presently provide.
2. Students can learn the material at their own pace and can readily communicate with other students, through e-mail or bulletin board systems to help promote learning and discussion of critical classroom issues. A database of questions can be assembled which will evaluate the student's increasing mastery of the subject. The potential for this technology to facilitate Advance Placement courses and accelerated degrees at the Uversity level is quite high.
3. Students will be able to duplicate the steps that a scientist actually takes in the analysis of real data and hence can be led into the important process of drawing inferences from

data. This aspect of science is usually lacking in most secondary school science curriculum. If the desire is to engage students in "hands-on" science, then one must provide those students with real data.

4. Teachers no longer need to be isolated from the most recent advances in their field. The computer network will allow teachers to access, maintain and extend their knowledge base by interacting with University researchers.

A very great promise imbedded in the high speed network is the explicit ushering if of a new era of cooperation between Universities and Secondary Schools with the sole goal of providing teachers more resources to work with and hence to develop a more concentrated (and modern) curriculum. The positive benefits of this implementation include the following:

1. New Alliances: School networking is a unique opportunity to provide access to greater resources and foster greater communication between research scientists, teachers, students, and the public. WWW/Mosaic will provide an excellent platform for the establishment of a hypermedia textbook that will continue to evolve through the combined activities of all of the participants. The use of the network should have a leveling effect where interest and motivation will become the important factor, rather than age or status, and as such a "learning community" will be established. The existence of this community will foster a team approach to scientific investigation.

2. Improved Education Networking and Science Education: As has been well-discussed in recent years, the instruction of science has had very little relation to the actual process of science. There is general consensus that the situation needs to be changed, and a variety of exciting new approaches are being implemented. Some of these approaches, such as Global Lab and Academy One, have made use of the infrastructure primarily for communication purposes. Extant networking technology,however, can go well beyond this as one can bring an environment equivalent to the environment utilized by scientists in the field of astronomy/physics

and Environmental Sciences to the classroom. The introduction of WWW and Mosaic provides an opportunity for the development of an online learning resource that can evolve through the activities of participants. The boundaries between learning and teaching will begin to disappear as teams of students, teachers, scientists, and the public participate in the generation of the learning resources.

3. Self-sustaining Project: The "learning community" concept will be transferable to other disciplines. The underlying technologies and the software to run the live remote investigations, and the telesimulations, will be transferable to other disciplines and will run on any Mosaic platform. Access to the material from home, via modem, will allow the students the means to organize themselves into Special Interest Groups (SIGS) that concentrate on a particular topic. Besides providing a sense of community, SIGs can offer mentoring to new members and pointers to information of interest to the group as a hole. In general, a well organized SIG leverages off of the entire group's talent.

In sum, moving towards an electronic classroom with full accessibility to worldwide information systems should be part of our general plan towards educating students to become responsible members of the global community. While one can and will quarrel over pedagogical aspects of how to best implement this, clearly the first step towards implementation is reasonable access to the information which is stored in a manner to allow teachers and students to effectively access it. Since the expertise for maintaining and distributing the computer based information and for developing curriculum based on actual University lecture material, resides at the University, then this proposed pilot program is a concrete step toward fully realizing an important goal -- making the OSSHE Institutions a local resource for all educators and students in the State of Oregon. The first step in realizing this goal is to educate, excite and train teachers about this new resource.

THE NEED FOR THE NETWORK BASED CURRICULUM TOOLS: THE SPRINGFIELD SCHOOL DISTRICT EXAMPLE AND DEMOGRAPHICS

The Springfield School District is comprised of both urban and rural schools. The District has recently been connected to the Internet. Springfield has drafted a technology plan and has a strategy for providing teachers with training on Internet resources during the summer of 1994. In February and August 1994, representatives from the Springfield School district attended a demonstration, held at the University of Oregon, on how the Internet can be used to form an electronic partnership between the University and local school districts for the purposes of developing more sophisticated and up to date core course curriculum, with a particular emphasis on science education. District personnel were enthusiastic about participating in this joint venture and will commit school district personnel to the project. Clearly, teacher training is an essential component to towards realizing efficient classroom implementation of various network resources. Electronic resource materials are available now and with appropriate training the District teachers can in fact make the electronic classroom a dynamic supplement to existing core course curricula for their students. This training requires funding for teacher stipends for release time to acquire the skills necessary to use the available electronic materials and the acquisition of appropriate workstation hardware at training sites to deliver an effective training curriculum.

The opporunity to train teachers and in turn make technology available to a rural community opens tremendous opportunities for the students and their families. The delivery of these electronic materials from the University will permit student participation and interaction and remove the geographic barriers. Teachers experiencing professional growth while collaborating with University researchers is a powerful model. In all disciplines, schools strive to bring students closer to experiencing the excitement, hard work, and satisfaction of real world contributions.

Springfield Public Schools has neither the fiscal or human resources to pursue a project of this magnitude without external assistance. This school system, based in a timber dependent community, is suffering severe budget cuts due to a state-wide property tax limitation. Class sizes have increased while classroom support has been severely reduced. However, the enthusiastic desire for an opportunity to participate in this project goes beyond material benefits. As the lines between levels and avenues of education begin to blur, teachers need the opportunity to interact with professionals in the disciplines about which they teach. The chance for teachers to collaborate with scientists, to teach students using real data from current research projects, and to bring the excitement of the profession into the classroom, is the direction in which we need to move. Current trends in education include authentic assessment, collaborative learning, life long learning skills, and problem solving. Allowing students the opportunity to interact and study with their teachers and professional scientists using global access to real world data models scientific inquiry illustrating each of these goals.

Finally, the state of Oregon is in the process of implementing a far-reaching program of school reform, that will bring students to the University with portfolios and outcomes-based assessments rather than traditional high school transcripts. OSSHE Institutions expect that these students will demand a much more personalized and more technologically sophisticated educational experience than has been the case in the past. The current economic and educational climate in Oregon is representative of problems that are on the horizon for many states across the nation. A property tax limitation measure is in mid-implementation, and by the end of the 1995-97 biennium, we will have moved the great majority of responsibility for funding primary and secondary schools from local to state-level taxes. One result is the dramatic reduction in funds for other state-supported services, including higher education.

As a result, K-12 schools and higher education are experiencing major reductions in funding. This is breaking down many traditional organizational barriers between the two education sectors, as school districts and universities seek means to address the projected growth in students. Between 1994 and 2010, a 40% increase in high school graduates is expected, impossibly straining the reduced resources for education. With an eye to the demographic projection and the grim financing decisions, better coordination is necessary among providers of education, including high schools, community colleges, universities, and continuing education programs. Clearly, more efficient means for education delivery must be found that maintain or improve upon existing quality.

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